PB89-188932

Superfund Record of Decision (EPA Region 1)
Groveland Wells Nos. 1 and 2 Site, Valley Site
Source-Control Organic Operable Unit, Groveland, Massachusetts
(First Remedial Action), September 1988

(U.S.) Environmental Protection Agency, Washington, DC

30 Sep 88

U.S. Department of Commerce
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Environmental Protection
Agency

Office of
Emergency and
Remedial Response

EPA/ROD/R01-88/030
September 1988

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EPA

Superfund Record of Decision:

Groveland Wells, MA

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16. Abstract (Limit: 200 words)

The 850-acre Groveland Wells site is located in the Town of Groveland, Essex County, Massachusetts within the lower Johnson Creek drainage basin. The site includes the watershed and aquifer which recharge two municipal supply wells, Station Nos. 1 and 2, and three known sources of soil, surface water, and ground·water contamination: the Valley site, the A.W. Chesterson site, and the Havenhill Municipal Landfill site. This remedial action addresses source control at the Valley site. The remaining operable units of the Groveland Wells site will be addressed in subsequent remedial actions. The 'alley site operable unit is located in the far northwestern section of the Town of Groveland, and is bordered to the north and south by residences within 100 feet of the site. The Town of Groveland's municipal water supply well, Station No. 1, is located approximately 3,500 feet northeast and downgradient of the Valley site, and is currently being treated to remove VOCs as part of an initial remedial measure by EPA. The Valley Manufactured Products Company (Valley) began operating a metals and plastic parts manufacturing business in 1963 on a 1.5-acre parcel of property owned by Groveland Resources Corporation (GRC). The Valley site area consists of the land within and immediately adjacent to the GRC property boundaries and contains three subsurface disposal systems, and an oil storage and recovery system consisting of six underground
(See Attached Sheet)

17. Document Analysis a. Descriptors

Record of Decision
Groveland Wells, MA
First Remedial Action
Contaminated Media: gw, sediments, soil, sw
Key Contaminants: metals (arsenic, lead), VOCs (PCE, TCE, toluene)

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement

19. Security Class (This Report) None

20. Security Class (This Page) None

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22. Price

(See ANSI-Z39.18) **See Instructions on Reverse**

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(Formerly NTIS-35)
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16. ABSTRACT (continued)

tanks and a 55-gallon drum storage area both of which were used to store cutting oils and solvents such as TCE and methylene chloride. These subsurface disposal systems dispersed liquid effluent into the ground by filtration through a sand and gravel leach field. According to Valley/GRC, more than 20 gallons of waste cutting oil containing TCE and other hazardous substances were released each month on the ground at the south end of the building between 1964 and 1972. Also, at least four 55-gallon drums of the same material was used as a defoliant on the eastern side of the building. Between 1979 and 1984, effluent from an acid bath finishing process was discharged to an underground leach field, and TCE-contaminated oil was released on the soil under a loading dock and into a floor drain. In 1973, 500 gallons of raw TCE was released from an underground storage tank into the soil, and additional waste oils and solvents were dumped on the ground. A site investigation in 1983 revealed high levels of TCE, arsenic, lead, and copper in the underground disposal systems. Additional sample analysis has detected soil contaminated with VOCs from the surface to a depth of 15 feet in various locations onsite. Analysis of surface water and sediments from Mill Pond, downstream of the Valley site, as well as ground water from monitoring wells in the site area, also detected VOC contamination. Based on the concentration of VOCs detected in the subsurface soil and ground water, and historical site use information, both media are believed to be contributing to ground water and surface water contamination in the Valley site area and the Mill Pond/Johnson Creek watershed and aquifer. The primary ontaminants of concern affecting soil, sediments, ground water, and surface water are VOCs including TCE, PCE, and toluene, and metals including arsenic and lead.

The selected remedial action for the Valley site operable unit includes: in situ vacuum extraction of approximately 20,000 yd^3 of unsaturated soil followed by activated carbon treatment of the extracted VOCs; onsite ground water pump and treatment by carbon adsorption and aeration, with recharge to the aquifer of a portion of the treated ground water upgradient of the site to accelerate removal of saturated zone soil contamination, and discharge of the remainder of the treated ground water to the aquifer downgradient of the site, and treatment of air emissions from the aeration process by carbon adsorption; ground water monitoring; and sealing or disconnecting all drains and lines to the acid bath finishing process disposal system. Incidental treatment of inorganic compounds and other contaminants will be provided as necessary in order to efficiently operate the VOC contaminant treatment system and to meet applicable discharge permit requirements. The estimated present worth cost of this remedial action is $4,165,000, with a 10-year present worth O&M cost of $2,677,000.

Record of Decision
Remedial Alternative Selection

Site Name and Location

Groveland Wells Nos. 1 & 2 Site
Valley Site Source-Control Organic Operable Unit
Groveland, Massachusetts

Statement of Purpose

This Decision Document presents the selected remedial action for an operable unit for the Valley Site portion of this NPL site organic contamination developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Contingency Plan (NCP); 40 CFR Part 300 et seq., 47 Federal Register 31180 (July 16, 1982), as amended. The Regional Administrator for Region I has been delegated the authority to approve this Record of Decision.

In accordance with CERCLA Section 121(f)(1)(E) and (G), EPA has provided the Commonwealth of Massachusetts with the opportunity to review and comment on the Remedial Investigation, the Feasibility Study; and the Proposed Plan for Remedial Action. The Commonwealth has concurred in the selected remedy for this operable unit and has determined, through a detailed evaluation, that the selected remedy is consistent with its laws and regulations.

Statement of Basis

This decision is based on the administrative record which was developed in accordance with Section 113(k) of CERCLA and which is available for public review at the information repositories (index attached). The attached index identifies the items which comprise the administrative record upon which the selection of a remedial action is based.

Description of the Selected Remedy

The selected remedy for the Valley Site is a source control action which will entail remediation of organic contamination in both soils and groundwater within the Valley Site boundaries. As such, the action addresses an operable unit of the larger Groveland Wells Site.

The soil remediation entails the following:

- In-situ vacuum extraction of approximately 20,000 cubic yards of unsaturated soils covering an area of approximately 25,000 square feet followed by activated carbon treatment of the extracted volatile organic contaminants.

- Vacuum extraction followed by carbon adsorption treatment is a proven, innovative technology which is effective in permanently removing volatile organic contamination, thereby treating unsaturated soils without the need for excavation. This technology was piloted at the site as part of the Superfund Innovative Technology Evaluation (SITE) Program.
- It is anticipated that the bulk of soil contamination will be removed and treated within one to two years, although five to ten years of operation may be required to attain the soil cleanup goals.

The groundwater treatment component entails the following:

- Active restoration of the overburden/bedrock aquifer contaminated primarily with volatile organic compounds (VOCs). The groundwater extraction/reinjection system will involve the installation of approximately four to six downgradient recovery wells and four to six upgradient recharge wells on site. To the extent that inorganics will need to be removed during treatment, this remedy will provide some remediation of inorganics contamination.
- Treatment of contaminated groundwater from the site for removal of volatile organic compounds (VOCs) by aeration and carbon adsorption. VOC emissions from the air stripper will be removed by carbon adsorption. A portion of the treated groundwater will be recharged to the aquifer upgradient of the site to accelerate contaminant removal from the saturated zone soils, while the remainder will be discharged downgradient of the site.
- It is anticipated that the bulk of the groundwater contamination will be removed in less than five years, although five to ten years of operation may be required to attain the VOC groundwater cleanup goals, which are set at drinking water standards or other appropriate health based goals.
- The final design of the groundwater recovery/recirculation and treatment system will be based on ongoing treatability studies performed by Valley under the terms of a Consent Order.

The estimated present worth cost for the source control soil and groundwater remediation is $4.1 million, which includes capital costs and present worth costs of operation and maintenance for the projected ten years of soil and groundwater treatment.

Declaration

The selected remedy is protective of human health and the environment, attains Federal and State requirements that are applicable or relevant and appropriate, and is cost-effective. This remedy satisfies the statutory preference for treatment that permanently and significantly reduces the volume, toxicity or mobility of the hazardous substances, pollutants and contaminants as a principal element to the maximum extent practicable. It is determined that this remedy utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.

9/30/88
Date

Michael R. Deland
Michael R. Deland
Regional Administrator, EPA
Region I

ROD DECISION SUMMARY

GROVELAND WELLS NOS. 1 & 2 SITE
VALLEY SITE ORGANICS SOURCE-CONTROL OPERABLE UNIT
GROVELAND, MASSACHUSETTS

September 30, 1988

U.S. Environmental Protection Agency

Region I

GROVELAND WELLS NOS. 1 & 2 SITE
VALLEY SITE ORGANICS SOURCE-CONTROL OPERABLE UNIT
Record of Decision Summary

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ROD DECISION SUMMARY

I. SITE NAME, LOCATION AND DESCRIPTION

SITE NAME:	Groveland Wells Nos. 1 & 2 Site
SITE LOCATION:	Town of Groveland, Essex County, Massachusetts
OPERABLE UNIT:	Source-Control For Organic Contamination at the Valley Manufactured Products Company, Inc./ Groveland Resources Corporation Site [The Valley Site]
SITE DESCRIPTION:	

The Valley Site is located at 64 Washington Street in a residential area, within the Groveland Wells Nos. 1 & 2 Site [the Groveland Site], in the northwestern-most portion of the Town of Groveland. See Figure 1. The Valley Manufactured Products Company, Incorporated (Valley) operates a metals and plastic parts manufacturing business which is housed in a 30,000 square foot building [the Valley Facility] on the approximately 1.5 acre property [the Property] owned by the Groveland Resources Corporation (GRC). See Figure 2. Valley/GRC has operated this manufacturing business on the Property since November, 1963.

Groveland Resources Corporation is the current owner of the Property. Valley Manufactured Products Co., Inc. is the current operator of the Property and Valley Facility. As such, GRC and Valley have been notified as responsible parties at the Groveland Site.

For the purpose of the feasibility study (FS) and this Record of Decision and implementation of this source-control remedy, the Valley Site is defined as the building and land within and immediately adjacent to the Property boundaries. For purposes of implementation of this remedy with respect to CERCLA §121(e)(1), "onsite" will refer to the entire Groveland Wells NPL Site. For the purpose of the remedial investigation (RI) and endangerment assessments (EA), the Study Area was defined as the Property and the area which abuts the Property on the east down to and including the Mill Pond. See Figure 3.

The Valley Facility has had interim status under the Resource Conservation and Recovery Act (RCRA) for the storage of hazardous waste since November 15, 1980. Waste is stored in the material storage area in the southern end of the building. See Figure 4.

The building and paved parking area occupy the majority of the Property, each covering 30,000 square feet or a total of approximately 90% of the Property. A narrow strip of land averaging approximately ten (10) feet wide runs along the southern and eastern portions of the building. The Valley Site is bounded generally to the west by Washington Street, to the north and south by residential homes within 100 feet and to the east by wooded property, currently owned by the Roman Catholic Archdiocese of Boston, which extends from the upland Property easterly to the Mill Pond wetland area. See Figure 5. The general area of the Valley Site is presently served by municipal water supply and private sanitary septic systems.

The Valley Site contains three subsurface disposal systems: the sanitary septic system; the truck loading well/storm water system (the truck well disposal system); and, the "Brite-Dip" metal parts cleaning rinse water disposal system (the Brite-Dip disposal system). The sanitary septic system consists of a septic tank, associated drains and piping, and a leachfield located under the existing parking lot. The Brite-Dip disposal system consists of a concrete distribution box, associated drains and piping, and a leachfield located outside the building's southeast corner. A floor drain in the former Brite-Dip acid dip room and one in the material storage area are connected to the Brite-Dip disposal system. The truck well disposal system consists of a drainage trough outside the front of the building, a presently sealed former floor drain in the truck loading dock area and associated drains and piping, connected to a storm water oil/gas separator, and a leachfield located along the eastern wall on the existing building. See figure 4.

In addition, an oil storage and recovery system exists at the Valley Facility. This system consists of five underground cutting oil storage tanks ranging in capacity from two thousand (2000) to three thousand (3,000) gallons. A sixth tank (700 gallons), which is presently empty, was used to store raw halogenated hydrocarbon solvent (hereinafter, referred to as solvents) (trichloroethylene from 1972 to 1979 and methylene chloride from 1979 to 1983). Lubricating or cutting oils are circulated to the milling machines inside the facility. These oils are circulated to the recovery system after use for cleaning and metals removal, before being recirculated for reuse. Waste oils are finally collected in 55-gallon drums for off-site disposal. The six storage tanks are located under the material storage area.

A more complete description of the Valley Site and the Study Area is contained in the Supplemental Remedial Investigation Report prepared by M. Anthony Lally Associates, July, 1988 (the SRI).

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

A. Site Use History

In May 1963, Groveland Resources Corporation (d.b.a. Valley Screw Products Co., Inc.) leased the Property and began

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operations. In November 1966, Groveland Resources Corporation (d.b.a. Valley Screw Products Co., Inc.) purchased the Property and continued to operate the manufacturing business on it. On August 1, 1979, Valley Manufactured Products Co., Inc. (a corporation organized and incorporated on May 31, 1979) acquired the manufacturing business operations of Groveland Resources Corporation at the Property. Groveland Resources Corporation is the current owner of the Property. Valley Manufactured Products Co., Inc. is the current operator of the Property.

Since operations began at the Property in May 1963, the three subsurface disposal systems described above in Section I have been installed and used. Each of these disposal systems disperses liquid effluent into the environment by filtration through a sand and gravel leachfield. The response history with respect to these disposal systems is discussed below in Section II.B.

Currently, two storm water disposal systems and one sanitary wastewater disposal system are in operation at the Valley Facility. The sanitary wastewater system is the same as that discussed above. The storm water disposal systems consist of the one associated with the oil/gas separator manhole, as discussed in the previous paragraph, and a new combination storm water/ compressor cooling water collection system. The latter collects storm water from the building roof, cooling water from an air compressor, and condensate water from the air conditioner. These flows are routed to eventually discharge to a twelve inch reinforced concrete drain pipe. This pipe extends from the Town of Groveland drainage system along Washington Street easterly across the northernmost portion of the Valley parking lot and then discharges to a drainage swale located on the abutting Archdiocese of Boston property, which swale extends easterly to Mill Pond.

The metal products manufacturing process conducted at the Property involves the lathing, degreasing, and finishing of metal parts. Cutting oils are used in the lathing operation. After use they are recycled and reused as described above in Section I. At the lathes, machined parts are hand-dipped in a solvent to degrease them for inspection. Until 1983, the finished oily machined parts were then placed in a solvent vapor degreaser. The Valley Facility now uses a detergent type degreaser. The final process step, an acid bath process known as "Brite-Dip," was used until sometime in 1984 to restore lustre to non-ferrous metal parts.

Hazardous wastes result from the lathing/degreasing operations (spent halogenated solvents and waste cutting oils) and formerly from acid bath operations (neutralized rinse water). Trichloroethylene (TCE) was used in the vapor degreasing operation from May 1963 to February 1979. Methylene chloride was used in the vapor degreasing operation from June 1979 to 1983. "Solvolsol", or

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equivalent solvent, has been used in the hand dipping of products for inspection from May 1963 to the present.

Since purchasing the Property in 1966, Valley/GRC has constructed several additions to the original building, known as the "Old Mill Building." From May 1963 to October 1972, Groveland Resources Corporation operated the manufacturing business in the approximately 7500 square foot Old Mill Building. The Old Mill Building had an attached 700 square foot wooden shed which was used to store: raw TCE, Solvolsol, and cutting oils; waste cutting oils containing TCE or other hazardous substances or Solvolsol; and, spent halogenated solvents containing TCE or other hazardous substances, or Solvolsol from degreasing operations.

In 1972 and 1973, Groveland Resources Corporation constructed an addition onto the Old Mill Building for manufacturing operations, installed six underground storage tanks for raw cutting oils, solvents and mineral spirits, and constructed a concrete slab over these tanks. From 1972 to 1979, fifty-five gallon drums of waste cutting oils and raw and spent solvents were stored on this concrete slab. In September 1979 a roof was constructed over the material storage area, which had been constructed in 1972. Fifty-five gallon drums of raw and spent solvents and waste cutting oils had continued to be stored on the slab. See Figure 3.

The following discussion relates to the historical disposal at the Valley Site of hazardous wastes: waste cutting oils and spent halogenated solvents. The information contained in this discussion is taken from the December 23, 1985 Valley/GRC response to an EPA request for information issued in September 1985. EPA does not purport to have validated the volume of waste discharged on the Valley Site. The actual volume may be greater.
Between 1964 and 1972 and possibly as late as 1974, at least twenty gallons of waste cutting oil containing trichloroethylene (TCE) or other hazardous substances were released each month onto the ground in the southern end of the existing building where the truck well loading dock and the material storage area concrete slab are presently located. Between 1964 and 1966 and possibly as late as 1972, at least three to four fifty-five gallon drums of waste cutting oil containing TCE or other hazardous substances were released as a defoliant on the eastern side of the building and in the area where the parking lot is presently located.

Between 1979 and 1984, effluent from the Brite-Dip acid bath process containing "Low Heat Cleaner #1" or "Dispoz-Aid 2", or their equivalent, were discharged to the Brite-Dip disposal system leachfield which is adjacent to the southeast corner of the building. Between 1979 and 1984, the Brite-Dip acid bath process was located inside the building in the southeast corner. In November 1980, the Brite-Dip disposal system was installed at its present location outside the southeast corner of the building.

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Between 1978 and 1979, the Brite-Dip process was located on an earthen floor in the basement near the compressor room, and wastewater from this process was discharged into the parking area.

In 1979, oil containing trichloroethylene, or other hazardous substances, was released from a chip spinner into the truck well floor drain and into the soil under the truck loading dock or to the east side of the building where the leachfield for the truck well disposal system, which was not constructed until 1980, is presently located. Between 1972 and 1980, the truck well floor drain was used without benefit of an oil/gas separator and leachfield. In April 1980, the existing truck well disposal system and leachfield were constructed. See Figure 3.

In 1973, at least 500 gallons of raw TCE was released from an underground storage tank into the soil beneath the concrete slab located in the south side of the building. Between 1966 and 1972, pails of waste cutting oil from lathes were emptied onto the ground in the areas where the truck loading dock and concrete slab are now located. The waste cutting oil contained Solvolsol or equivalent solvent.

B. Response History

Each of the three subsurface disposal systems was initially sampled during a joint EPA/State RCRA inspection in January and March 1983. Analysis of samples collected from the truck well oil/gas separator detected concentrations of trichloroethylene as high as 44,000 micrograms per liter (ug/l or parts per billion, ppb) and the inorganic compounds arsenic, lead, and copper as high as 460 ppb, 61,800 ppb and 1,380 ppb, respectively. The truck well disposal system was installed after the purported one-time release from the chip-spinner discussed above in Section II.A. In addition, analysis of samples from the Brite-Dip distribution box detected concentrations of the inorganic compounds lead and copper as high as 2,380 ppb and 4890 ppb, respectively.

As a result of the sampling programs and site inspections conducted by Valley and the Massachusetts Department of Environmental Quality Engineering (DEQE), a Consent Agreement and Order under Massachusetts General Laws (MGL) Chapter 21C was entered into between Valley and the DEQE Division of Water Pollution Control (DWPC). The Consent Agreement, dated August 24, 1983, was intended to bring the plant discharges into compliance with State and Federal Regulations and entailed submission of plans as well as a sampling program for each disposal system. As a result of this Consent Agreement, it was determined that the existing Brite-Dip metal parts cleaning system would be eliminated. This system, which included rinse water tanks, cleaner holding tanks, and a wastewater treatment system, was disassembled and removed in May of 1984. Incoming water supply lines to the system were cut and the existing floor drain plugged with a PVC cap. The subsurface disposal system, consisting of distribution box and leaching field, remains in place. Also, a drain in the material storage area slab is connected to the Brite-Dip disposal system.

To eliminate the need for future sampling of the truck well disposal system, it was agreed between Valley and the DWPC that the existing truck loading well floor drain would be relocated to outside the building, where storm water would be collected by a drainage trough and conveyed to the existing oil/gas separator manhole for final disposal into the existing leachfields, which are located at the rear of the facility.

Tightness testing of the underground storage tanks and smoke tests of the floor drain line from the truck loading well to the oil/gas separator was also performed for Valley/GRC in 1983.
It was reported that no smoke was detected within the building. [Letter dated November 23, 1983 from Lally Associates to DEQE-DWPC]. With respect to the tank testing, it was reported that they were in good condition and free from any leakage of their contents. The only leakage reported was determined to be from the 2" couplings at the tank vents [Letter Report Re: Underground Tank Air Testing, Water & Waste Pipe Testing].

The DEQE entered into a Second Consent Agreement and Order with Valley on March 8, 1984 for performance of a remedial investigation and feasibility study and implementation of remedial action. On March 30, 1984 EPA issued an Administrative Order to Valley under the authority of RCRA §3013 to conduct a remedial investigation. The Valley RI/FS, performed in 1984 and 1985 under those orders, was determined to be grossly inadequate and as a result did not provide the basis for selection of a source-control or a management of migration remedy. An analysis of this first RI/FS is contained in the report entitled Groveland Wells Technical Review of Documents, February 1986, GCA Corporation Technology Division (now known as, Alliance Technologies). At that time, GCA also developed an endangerment assessment, which is entitled, Valley Manufactured Products Company, Endangerment Assessment, Final Report, Alliance Technologies Corporation, September 1987 (the EA). The EA was based on existing data on contamination of environmental media contained in the report entitled Data Management Task Report, Alliance Technologies, July 1987 (the Data Management Report). Alliance also developed scopes of work for leachability and geophysical studies. These scopes of work were used in developing the workplan for the Supplemental RI performed by Valley/GRC, which is discussed below.

A CERCLA §106 Administrative Order on Consent, Docket No. 1-87-1091 (the Consent Order), was entered into with Valley/GRC on September 4, 1987 for performance of a Supplemental RI after substantial development and negotiation of a detailed workplan.

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The results of the first and this supplemental RI are presented in the report entitled, Final Phase I Supplemental Remedial Investigation Report, Docket No. 1-87-1091, Valley Manufactured Products Co., Inc., Groveland Resources Corporation, Groveland, Massachusetts, M. Anthony Lally Associates (the SRI). EPA contractor Camp, Dresser & McKee provided oversight of this activity and prepared an endangerment assessment amendment, which is entitled, Amendment To The Valley Manufactured Products Company Endangerment Assessment, August 1, 1988, Camp Dresser & McKee (the EA Amendment). EPA contractor Roy F. Weston developed a source-control feasibility study, which is entitled, Feasibility Study For The Cleanup Of Volatile Organic Compounds, Groveland Valley Site, Groveland, Massachusetts, September 1988, Roy F. Weston (the FS).

In December 1986, the Valley Site was nominated for a demonstration of the Terra-Vac, Inc. soil vapor vacuum extraction system (VES) under the EPA Superfund Innovative Technology Evaluation (SITE) program. The Valley Site was chosen by the SITE Program for demonstration, and a continuous demonstration of the VES was conducted from February through April, 1988. During this fifty-six day demonstration, approximately 1300 pounds of VOCs were recovered by carbon adsorption from four extraction wells outside the material storage area.

On August 2, 1988, EPA and Valley/GRC entered into Modification No. 1 to the Consent Order (Consent Order Modification) for the performance of groundwater and soil vapor vacuum extraction treatability studies, which studies are ongoing. For performance of the soil treatability studies, Valley/GRC has contracted with Terra-Vac, Inc. to install three vacuum extraction and one soil gas monitoring well inside the building. Figure 6-1 depicts the locations of these wells and the extraction and monitoring wells installed during the SITE demonstration project and the Consent Order Modification.

A more detailed description of the Valley Site history can be found in the Supplemental Remedial Investigation Report at pages I-2 to I-14.

See Section IV below for a discussion of additional response actions that have been executed or are planned for the Groveland Wells NPL Site.

C. Enforcement History

On November 13, 1983, EPA notified three parties who either owned or operated the Valley facility, generated wastes at the facility or arranged for the disposal of wastes at the facility of their potential liability with respect to the Groveland Wells Site.

To date, these negotiations have resulted in the performance of remedial investigation work and provision for reimbursement of EPA oversight costs.

Requests for information on site use were issued to Valley/GRC in November 1983. After conducting an investigation of site use which included personal interviews in 1984 and 1985, EPA issued additional information requests in September and November 1985. The responses to these requests confirmed that disposal on the Valley Site had occurred throughout the period of operation of the Facility. In November 1987 and May 1988, EPA issued requests for financial information to Valley/GRC.

The PRPs have been active in the RI/FS and remedy selection process for this Site. Technical comments presented by PRPs during the public comment period have been reviewed and evaluated in developing this record of decision. A summary of their comments and detailed responses to them is contained in the Responsiveness Summary in Appendix A, while their complete comments are included in Attachment C of the Responsiveness Summary. [Comments of Valley Manufactured Products Company, Inc. and Groveland Resources Corporation on EPA Valley Site Proposed Plan, September 7, 1988].

III. COMMUNITY RELATIONS

Throughout the Groveland Wells Site's history, community concern and involvement has been substantial. EPA has kept the community and other interested parties apprised of the Site activities through informational public meetings, fact sheets, press releases and public hearings.

In September 1983, EPA released the first site community relations plan which outlined a program to address community concerns and keep citizens informed about and involved in activities during remedial activities. This original plan has been updated as necessary for all subsequent remedial activities.

The Agency published a notice and brief analysis of the Proposed Plan (the Proposed Plan) in the Haverhill Gazette on August 4, 1988 and made the Plan available to the public at the Langely-Adams Public Library and Town Clerk's Office in Groveland at that time.

On July 26, 1988, EPA held an informational meeting to discuss the results of the remedial investigation and the cleanup alternatives presented in the FS and to present the Agency's Proposed Plan. Also during this meeting, the Agency answered questions from the public. From August 4, 1988 to August 26, 1988, the Agency held a three week public comment period to accept public comment on the alternatives presented in the FS and the

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Proposed Plan and on any other documents previously released to the public and in the Administrative Record. On August 9, 1988, the Agency held an informal public hearing to accept any oral comments. No comments were read into the record at this hearing. A transcript of this hearing and the Agency's response to comments received during the public comment period are included in Appendix A of the Responsiveness Summary.

On August 17, 1988, EPA sent Proposed Plan Clarifications to interested parties. These clarifications are discussed in detail below in Section VII. In consideration of the substance of these clarifications, no extension to the public comment period was given. However, in consideration of the ongoing Consent Order Modification work by Valley/GRC, they were afforded the opportunity to submit comments on the Proposed Plan up to September 7, 1988, which comments are presented and responded to in the Responsiveness Summary.

IV. SCOPE AND ROLE OF OPERABLE UNIT OR RESPONSE ACTION

The Groveland Wells Site, which was included on the National Priorities List (NPL) in December 1982, is classified as a Federal Fund-Lead site. The Groveland Wells Site (Figure 1) consists of approximately 850 acres within the lower Johnson Creek drainage basin and includes the watershed and aquifer which recharge two gravel-packed municipal supply wells, Station Nos. 1 and 2, and three known sources of soil, surface water and groundwater contamination: the Valley Site, the A. W. Chesterton Site and the Haverhill Municipal Landfill Site. Station Nos. 1 and 2 were ordered closed by the MA DEQE in June and October 1979, respectively, due to contamination by trichloroethylene.

A multi-source groundwater response plan has been developed to address the Groveland Wells Site contamination and includes the following principal components, planned or executed. The Valley Site source-control operable unit is discussed below at (6).

A potential link between contamination at the Valley and Haverhill Landfill Sites and the contamination at Stations No. 1 and No. 2 was demonstrated through use of a numerical groundwater flow model in EPA's 1984/1985 aquifer-wide RI/FS discussed below in (3). Aquifer response data being collected during operation of Station No. 1, discussed below at (1) should contribute to a better understanding of the Groveland Wells Site contamination.

(1) Provision of alternative water supply by restoration of municipal well Station No. 1 with well-head treatment.

By Action Memorandum dated July 25, 1985 EPA approved an initial remedial measure to provide an alternative water supply by rehabilitating Station No. 1 with granular activated carbon treatment for volatile organics, based on an EPA evaluation of water supply/demand and an aquifer-wide RI/FS. Station No. 1 was brought into service in August 1987 and again in May 1988. Station No. 1 with the granular activated carbon treatment system now provides a safe supply of water and will be operated with treatment until such time as source and management of migration actions effectively eliminate the need for that treatment. A Superfund State Contract currently assures State operation and maintenance of the system until February 1991. Aquifer response data being collected during operation of Station No. 1 should contribute to a better understanding of the historic contamination of it.

(2) Development of an Aquifer Protection Plan for the lower Johnson Creek aquifer.

In 1985, the Town completed development of an aquifer protection plan for the lower Johnson Creek aquifer. This aquifer protection plan established aquifer recharge zones, zoning by-laws, and recommendations for aquifer protection and restoration for long-term use of Station No. 1.

(3) Operable unit for management of contaminant migration within the Johnson Creek watershed and aquifer.

EPA performed aquifer-wide management of migration (MOM) RI/FS work in 1984 and 1985 and will perform supplemental MOM RI/FS work starting in 1989, in preparation of a fiscal year 1990 MOM ROD. This supplemental MOM RI/FS will characterize the existing surface water and groundwater contamination in the Mill Pond/Johnson Creek watershed and aquifer and evaluate MOM remedial alternatives. It will consider the selected source-control remedial action for the Valley Site and the remediation of Station No. 1, and the Mill Pond groundwater recovery and treatment system. This operable unit will therefore provide remediation of residual contamination in the Study Area and Mill Pond/Johnson Creek watershed and aquifer. Based on EPA's aquifer-wide RI/FS and focused RI/FS work in the Mill Pond area performed under the State's Water Supply Contamination Correction Program (MGL Chapter 286), the DEQE entered into a Consent Agreement (MGL Chapter 21E) with Valley/GRC to construct a groundwater recovery and treatment system at the Mill Pond. This system was put in service on April 1, 1988.

(4) Source-control remediation at the A. W. Chesterton site.

An RI was performed by Chesterton in 1984 and 1985 pursuant to a RCRA §.3013 Administrative Order on Consent entered into with EPA on March 30, 1984. This RI determined that the source of contamination was a subsurface disposal system on the Chesterton property and that soil, groundwater, and surface water contamination was limited to the Chesterton property and appeared not currently connected to contamination in the Valley/Mill Pond area or the Stations No. 1 or No. 2 area. Chesterton is a RCRA interim status treatment, storage, and disposal facility. A corrective action/closure plan has been submitted to EPA and DEQE. Future plans are to execute corrective action and closure at the Chesterton facility using RCRA authority.

(5) Source-control remediation at the Haverhill Municipal Landfill Superfund Site.

The Haverhill Landfill was originally named as a potential source of contamination which forced closure of Stations No. 1 and No. 2. EPA's aquifer-wide RI/FS investigated contamination at the landfill. The Haverhill Site, which is situated less than one hundred feet from the Merrimack River and the Johnson Creek, was included on the NPL in October 1984. To date, a title search has been completed and a responsible party (RP) Search is ongoing to establish operations history and identify generators and transporters. Future source-control and MOM remedial action is planned for this site.

(6) Operable unit for source-control organic remediation at the Valley Site.

Source-control remediation at the Valley Site is the subject of this ROD. Further discussion of the Valley Site history is provided above in Section II.

This remedial action addresses organic compounds in the two principal contaminated media of subsurface soil and groundwater. Based on the concentrations of volatile organic compounds detected in these media, and information related to historical site use, both media are contributing to groundwater and surface water contamination in the Study Area and Mill Pond/Johnson Creek watershed and aquifer.

By implementing soil and groundwater organics remediation at the Valley Site, contamination of groundwater will be reduced and minimized. Migration of contaminated groundwater which eventually discharges to Mill Pond and Johnson Creek, thereby contaminating those water bodies, will likewise be reduced and minimized.

The subsequent management of migration (MOM) remedial action described above in (3) will address residual/existing contamination in the Mill Pond/Johnson Creek watershed and aquifer. This MOM remedial action will be governed by existing drinking water standards for groundwater and ambient water quality criteria for surface water, which are applicable or relevant and appropriate requirements at the Groveland Site.

This source-control remedial action primarily addresses volatile organic soil and groundwater contamination. Incidental treatment of inorganic compounds and other parameters, as necessary, is provided as part of the groundwater treatment for volatile organic compounds. This is necessary in order to efficiently operate the selected air stripping/carbon adsorption treatment system and to meet the applicable requirements of the Massachusetts Ground Water Discharge Permit Program (314 CMR §5.00). As discussed below in Section V.D, the aquifer underlying and downgradient of the Valley Site is a Class I under the State classification system (314 CMR §6.03). Discharges to a Class I aquifer are required to meet primary and secondary effluent limitations established in 314 CMR §5.10.

CERCLA remedial actions, at a minimum, must attain applicable or relevant and appropriate requirements of federal and state environmental statutes (ARARs) and be protective of human health and the environment. It can be anticipated that remediation at the Valley Site under CERCLA will require cleanup of groundwater for all organic and inorganic contaminants to attain chemical-specific ARARs including: the Maximum Contaminant Levels (MCLs) established under the Safe Drinking Water Act (SDWA); the Massachusetts Ground Water Quality Standards established in 314 CMR §6.00; and, the RCRA Ground Water Protection Standards established in 40 CFR Part 264.92 to the extent that they are more stringent.

Table VI-4 lists the applicable or relevant and appropriate ground water quality and discharge standards for groundwater treatment for the inorganic contaminants of concern and secondary effluent parameters.

At the time of the CERCLA five year statutory review or at such time as the remedy has achieved the cleanup goals for the volatile organic contamination, or at some earlier time, EPA will evaluate whether the inorganic standards established under 314 CMR §6.00, the SDWA and RCRA, which are presented in Table VI-4, and general standards of protectiveness have been attained or are attainable. A determination as to whether such standards are attainable will consider the background or ambient concentration and residual soil contamination of these compounds at the Valley Site. If these standards are attainable, but have not been attained at that time, a determination as to whether continued groundwater treatment or soil remediation for inorganic contamination is necessary will be made in a supplemental decision document to this ROD. Such selection of continued groundwater treatment and soil remediation will be based on statutory criteria and consideration of the nature and extent of residual saturated and unsaturated soil contamination, and the nature and extent of residual contamination in the subsurface disposal systems and underground storage tank area.

V. SITE CHARACTERISTICS

The significant findings of the remedial investigations are summarized below. A complete detailed discussion of site characteristics is contained in the RI and SRI Reports.

A. Morphology

Topographically, the Valley-Mill Pond area (the Study Area) is characterized by irregular terrain of small hills and narrow ridges separated by low lying areas. Elevation in the Valley-Mill Pond area ranges from a high of elevation 150 west of Washington Street, to a low of elevation 33 in the Mill Pond area. The topography of the area is a reflection of the underlying land forms which are glacial in origin. All drainage within the Study Area ultimately reaches the Johnson Creek, the Mill Pond, and the Merrimack River via Johnson Creek.

B. Hydrogeologic Setting

1. Surface Water Hydrology

The Valley Site is located within the Johnson Creek drainage basin. Johnson Creek is a tributary to the Merrimack River. The Johnson Creek drainage basin, above Mill Pond, covers an area of approximately 6.4 square miles. The major surface water bodies within the drainage basin are Hovey's Pond and Johnson's Pond located to the south of the Study Area. Johnson Creek, the predominant stream in the area, originates south of the Groveland Wells Site and flows in a northerly direction to Mill Pond, located approximately 450 feet east of the Valley Site. Based on the runoff rate to Johnson's Pond obtained from the United States Department of Agriculture Inventory of Potential and Existing Reservoir Sites, Merrimack Study Area, March 1970, it was calculated that peak runoff to Mill Pond in a 100 year storm would equal approximately 1,700 cubic feet per second.

A control structure at the northernmost end of Mill Pond regulates the level of the pond and downstream flows. Excess waters from Mill Pond are released over the control structure and flow in a northerly direction approximately 3,700 feet to the Merrimack River. Downstream of Mill Pond two tributaries to Johnson Creek, Haverhill Brook and Agrilla Brook, discharge to Johnson Creek, increasing the Creek's discharge rate to the Merrimack River.

2. Geology

The Study Area is underlain by glacial materials deposited during the passage of ice sheets of the Pleistocene Epoch. A till drumlin lies just to the west of the Valley Site, and to the east is the Johnson Creek stream valley. Overburden materials indicate that a transition from glaciofluvial (ice contact and outwash) deposits to till underlie the site. The thickness of

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unconsolidated deposits under the site is on the order of thirty-two to fifty feet.

A dense basal or lodgement till, composed of dense, unsorted and unstratified silty sands and some gravel, ranges from two to five feet thick over the bedrock at the site. A compacted outwash sand and gravel strata of eight to ten foot thickness overlies this basal till. An ablation till, which is coarser grained than the lodgement till, ranges from four to eight feet thick above the outwash. This till is overlain by a layer of medium to fine sands and gravel located at or near the surface north and east of the site.

A thin irregular clay layer two to ten feet thick lying at a depth of six to twelve feet below the ground surface was found primarily under the southern end of the Valley Site overlying the outwash sand.

Bedrock beneath the Valley Site has been described as the Merrimack Quartzite Formation. The bedrock has a schistose texture and is composed of mostly fine grained phyllites and mica shist. The depth of bedrock ranges from thirty-two to fifty feet within the Study Area. The upper five to ten feet is composed of soft phyllite. The phyllite is gneissic with the foliation dipping between 30° and 50°. Joints for the most part are parallel to the foliation but occasional vertical and horizontal joints were also observed. The bedrock becomes quartzitic with depth but maintains similar structural attitudes. The bedrock surface dips to the south toward Center Street and to the east toward Johnson Creek valley.

3. Hydrogeology

The aquifer in the Study Area is a relatively thin phreatic aquifer which occurs in the overburden soils and shallow weathered bedrock. The depth to the water table is twenty-five to thirty feet below the ground surface. The aquifer materials are granular soils of glacial origin which fill a relatively narrow north/south winding valley. The valley is bounded on the east and west by glacial till/bedrock controlled uplands which are less pervious than the granular valley deposits. The unconsolidated materials overlie bedrock at thicknesses of up to fifty feet at the Valley Site.

C. Environmental Contamination

All data presented and discussed below appear in the Supplemental RI Report, unless otherwise noted.

1. Air

It was concluded in the SRI that "air contaminant concentrations detected in this area are generally low with no known health impacts at this level and are probably due to oils and greases being used within the machining equipment and not chemical contamination existing on the site." The SRI indicates the total level of organic vapors detected on site with an HNu was 3 parts per million (ppm) outside the machining area of the building.

2. Soil

Based on laboratory analysis of subsurface soil samples the most significant soil contamination, ranging in concentration from 10 ug/g (micrograms per gram, parts per million or ppm) to 2552 ug/g total volatile organic compounds (VOCs), has been found in the southernmost portion of the Valley Site, beneath and outside of the material storage area of the existing building. See Figure 7. The highest concentration of contaminants, 2552 ug/g total VOCs, was detected in subsurface soils within ten feet of the solvent storage tank. Concentrations of soil contamination generally decreased away from this area.

In addition, analysis of subsurface soil gas samples collected from an area under the building detected soil gas concentrations of VOCs as high as 1300 ppm, indicating that additional subsurface soil contamination may exist under this area of the building, which was constructed in 1974. See Figure 7.

The primary contaminants detected in these soils were trichloroethylene (TCE) and methylene chloride (M/C). Both compounds were historically used as degreasing agents within the Valley Facility. TCE, the major contaminant at the Valley Site, was used in the facility up to 1979. At that time, the use of TCE was discontinued and M/C was substituted as the degreasing agent. The use of M/C was discontinued in July 1983, and a detergent type degreaser is currently being used in the degreasing operation.

In addition to TCE and M/C, lesser concentrations of 1,2-trans-dichloroethylene (DCE) ranging from below detection limits or non-detectable (ND) to 12 ug/g, 1,1,1-trichloroethane (TCA) ranging from ND to 1.4 ug/g, and tetrachloroethylene (PCE) ranging from ND to 40 ug/g were detected in subsurface soil samples. These compounds were not known to be used at the Valley Facility in the past and their presence in soil may be a result of biodegradation of TCE and M/C or these compounds may have been present as contaminants in the TCE and M/C used at the Valley Facility.

Based on information submitted by Valley/GRC in response to an EPA request for information in September 1985, it is believed that no less than 3000 gallons of waste oil and solvent were historically released on the Valley Site. Five to seven hundred gallons of TCE came from a storage tank leak and the balance from indiscriminate disposal. EPA had previously issued two information requests, responses to which did not contain this information.

Volatile organic soil contamination is generally contained within soils above the clay lense. These soils generally consist of coarse sands and gravel. The contamination begins just below land surface and extends down to the top of the clay lense, which occurs at an average depth of ten to fifteen feet. Below the clay lense contamination levels are generally less than 100 ppm. It appears that contamination is largely trapped above the clay layer or is being attenuated within the clay layer. However, installation of monitoring wells through this clay lense generally compromises its' integrity.

Although soils in the Brite-Dip and truck well disposal system leachfields have not been sampled and analyzed to date, these leachfields are expected to be sources of residual organic and inorganic contamination based on the historic release of hazardous wastes to them and the detection of contaminants in the oil/gas separator and distribution box in 1983. This data is discussed above in Section II.B.

3. Surface water/sediment
Analysis of surface water samples near the southern shore of the Mill Pond, downstream of the Valley Site, detected concentrations as high as 760 micrograms per liter (ug/l, parts per billion, or ppb) DCE, 3400 ppb TCA, and 3200 ppb TCE. Chromium was also detected in surface water at this location at concentrations as high as 11 ppb (Data Management Report, Alliance, July 1987).

Analysis of sediment samples near the southern shore of Mill Pond, downgradient of the Valley Site, detected concentrations as high as 4390 milligrams per kilogram (mg/kg, parts per million, or ppm) aluminum, 7 ppm arsenic, 12 ppm barium, 10 ppm chromium, and lead 65 ppm (Data Management Report, Alliance, July 1987).

4. Groundwater
Monitoring wells have been installed at twenty-six locations in the Study Area. Three of these locations, which are on the Archdiocese of Boston property to the east, consist of nested bedrock and overburden wells. Six groundwater monitoring wells are located within the Valley building. See Figure 6. Recently, VOC concentrations as high as 150,000 ug/l TCE and 7900 ug/l DCE have been detected within the Study Area and adjacent to the Property and concentrations of 150,000 ug/l TCE, 23,000 ug/l DCE, 1100 ug/l TCA and 520 ug/l TCA have been detected under the material storage slab.

Based on data collected on the Valley Site to date, the main source of the groundwater contamination is the presence of residual organic compounds in the unsaturated soil beneath and outside of the material storage area. This contamination is likely due to the past storage and release of raw materials and hazardous waste in this area and the leak from the underground solvent storage tank. Prior to construction of the material storage area in 1980, spent cutting oils and solvents used at the facility were stored in fifty-five gallon drums on the ground and later on an open concrete slab. Since 1972, unused cutting oils and solvents have been stored in underground tanks in the same area. If these storage tanks leak, leachate would percolate downward through the soil matrix to the water table.

Construction of the existing material storage area enclosure in 1980 largely sealed the area from infiltration of precipitation. Prior to this, precipitation would runoff the material storage area and percolate downward through the soil matrix to the water table.

Inorganic compounds at levels above maximum contaminant levels (MCLs) were detected under the storage slab in July 1986: arsenic, 230 ug/l; chromium, 70 ug/l; copper, 1100 ug/l; and, lead, 130 ug/l. Samples collected adjacent to the Property on the east exhibited lower levels of these compounds. In samples collected in July 1988, inorganic compounds levels for the same wells had maximum detected concentrations of: arsenic, 10 ug/l; chromium, ≤20 ug/l; and, lead, 80 ug/l [Letter Report dated August 23, 1988, Lally Associates]. Although cadmium and copper were not detected in this analysis, the reported analytical detection limits for these compounds was greater than the MCL. The presence of elevated concentrations of inorganics may be attributed to cutting oils in soil and groundwater. In 1986 and early 1988, groundwater samples collected from under the material storage area exhibited a phase separation of oil, which was not observed in the July 1988 sampling. This oil phase was analyzed and determined to be primarily composed of kerosene or light petroleum fraction and a weathered #2 fuel oil or middle petroleum distillate [Laboratory Data Report, Lawrence Experiment Station (LES), analysis date 3/22/88 and Laboratory Memorandum, LES, dated July 31, 1985].

D. Groundwater Classification and Use

The surficial aquifer beneath and downgradient of the Valley Site is classified as a Class I by the Commonwealth of Massachusetts (314 CMR §6.03), which is groundwater designated as a source of potable water supply.

Under the EPA Groundwater Classification System [EPA Groundwater Protection Strategy (GWPS), Office of Groundwater Protection, August 1984], this aquifer is classified as a Class II. The policy under the GWPS establishes groundwater protection goals based on the "highest beneficial uses to which groundwater having significant water resources value can presently or potentially be put." Guidelines for protection of aquifers are based on characteristics of vulnerability, use, and value. The aquifer beneath and downgradient of the Valley Site is considered to be a current drinking water source since groundwater is used for drinking within a two-mile radius of the site (the classification review area).

Although there are presently no private/public users of this aquifer within 1/2 mile of the Valley Site, Groveland's municipal water supply well, Station No. 1, is developed in the highly productive surficial aquifer within the lower Johnson Creek drainage basin, approximately 3500 feet northeast and downgradient of the Valley Site. As discussed above in Section IV(1), Station No. 1 is currently being used as a public water supply. This supply is being treated with a granular activated carbon treatment system constructed by EPA as an initial remedial measure, to remove VOCs.

See Sections VI.D and X.B below for a discussion of target groundwater cleanup levels and the rationale for their selection.

VI. SUMMARY OF SITE RISKS

Endangerment assessments were performed for the Study Area to estimate the probability and magnitude of potential adverse human health and environmental effects from exposure to contaminants associated with the Valley Site. The significant findings of the endangerment assessments are summarized below. A complete discussion of the selection of contaminants of concern and human health risks can be found in the EA (Alliance, 1987) and the EA Amendment (CDM, 1988). A complete discussion of environmental exposure can be found in the EA (Alliance, 1987).

A. Contaminants of Concern

The EA was developed by Alliance Technologies based on environmental sampling and analysis performed for the Valley RI between 1984 and 1986. Alliance selected eight volatile organic compounds as contaminants of concern. The EA Amendment was performed by Camp Dresser & McKee (CDM) based on the results of additional sampling and analysis performed by Valley in 1986 and as part of the Supplemental RI performed by Valley in 1988. Based on this additional contaminant characterization, CDM selected six inorganic compounds to add to the list of contaminants of concern.

The organic and inorganic contaminants of concern and their distribution in environmental media in the Study Area are listed in Table VI-1. These contaminants constitute a representative subset of the more than fifty volatile and semi-volatile organic, and inorganic contaminants identified during the remedial investigations. The fourteen contaminants of concern were selected to represent potential onsite hazards based on toxicity, concentration, mobility, and persistence in the environment. Of the fourteen contaminants of concern, six are either known or suspected carcinogens.

VOCs constituted the majority of contaminants detected at the Valley Site, with TCE being the most abundant. TCE was detected at the greatest concentration of all contaminants: in soils at a concentration of 2,500 ppm and in groundwater at a concentration of 150 ppm. A summary of sample analysis data is contained in the Data Management Report, Alliance Technologies, July, 1987 and in the Supplemental Remedial Investigation Report, M. A. Lally Associates, July, 1988.

B. Human Health Risk Assessment

Potential human health risks associated with the contaminants of concern in soils, groundwater, surface water, and air were estimated through the development of several hypothetical exposure scenarios. Incremental lifetime cancer risks and a measure of the potential for noncarcinogenic adverse health effects were estimated. Exposure scenarios were developed to reflect the potential for exposure to hazardous substances based on characteristic uses and the location of the Valley Site. Two major potential receptor populations were identified. These include employees at the Valley Facility and the residential population in close proximity to the Valley Site. For each of these populations, risks posed by relevant exposure pathways were evaluated.

The following list represents potential human exposure pathways within the Study Area:

- direct contact with soils;
- ingestion of soils;
- ingestion of groundwater;
- ingestion of surface water; and
- direct contact with surface water.

A dose-response assessment was performed for each contaminant of concern to determine the nature and severity of actual or potential adverse health effects associated with the above exposure pathways. The toxic effects associated with the contaminants identified at the Valley Site range from headaches and minor skin irritation to liver, kidney, respiratory, and central nervous system damage, and cancer.

The greatest potential risk identified for the Valley Site is attributed to the ingestion of contaminated groundwater. At present, groundwater in the general area of the Valley Site is not known to be consumed, owing to the availability of the public water supply. Thus the risks estimated for the ingestion of groundwater correspond to possible future risks if groundwater was consumed. Groundwater is currently being withdrawn for municipal supply approximately 3500 feet northeast of the site from Groveland's Station No. 1.

The upper bound of the carcinogenic risk estimates posed by ingestion of the six carcinogenic contaminants of concern in groundwater ranged from $8x10^{-3}$ to $6x10^{-2}$ for average and maximum concentrations, respectively. Trichloroethylene and arsenic were the two contaminants that contributed most significantly to these risk levels. Mean concentrations of three of the six carcinogens also exceeded the current maximum contaminant levels (MCLs) promulgated under the Safe Drinking Water Act.

The noncarcinogenic health risks posed by contaminants at the Valley Site were also evaluated. Groundwater concentrations were evaluated against available reference doses (RfD) or other suitable health based criteria. The hazard index is used to describe the ratio between the chronic daily intake (CDI) and the RfD and is a measure of the potential for noncarcinogenic health effects. The hazard index exceeded unity for trans-1,2 dichloroethylene and lead under the average and reasonable worst case exposures scenario. Hazard indices for methylene chloride and toluene exceeded unity only for the reasonable worst case exposure scenario. EPA considers a hazard index less than unity acceptable for noncarcinogenic compounds. As a result of the carcinogenic and noncarcinogenic risk evaluation, groundwater at the site is deemed unsuitable for human consumption. That is, the incremental lifetime cancer risk exceeds the target risk range of 10^{-4} to 10^{-7} and noncarcinogenic health effects are of concern.

For the assessment of possible risks posed by dermal contact and ingestion of contaminated soils, subsurface soil contamination data was used, as surface soils were relatively clean. The resulting risk estimate may thus overestimate current risks but was selected to characterize future risks resulting from possible future site use. Two populations, workers and small children, were identified as having the greatest potential for exposure based on likely behavior patterns. Possible risks under the reasonable worst-case exposure scenario for each of these populations, was found to be within the acceptable CERCLA target risk range of 10^{-4} to $10^{-}7$. Since the contamination in soils resided at a depth of 4 to 25 feet below the surface, and since the risks fell within EPA's target risk range, the soil exposure pathways were not considered a significant health risk.

Similarly, risks to children resulting from the direct contact with or the ingestion of surface water from Mill Pond were not associated with a significant public health risk.

Table VI-2 presents a summary of potential risks by exposure pathway.

C. Environmental Exposure

Subsurface soils at the Valley Site are contaminated with volatile organic and inorganic compounds which result in groundwater contamination on-site. This groundwater migrates from the Valley Site, continually contaminating the Johnson Creek aquifer and the Mill Pond/ Johnson Creek surface waters, sediments and biota through groundwater discharge.

D. Cleanup Goals/Area of Attainment

Based upon a review of the applicable or relevant and appropriate criteria, standards and requirements of state and federal environmental laws and the associated risk levels, EPA has established groundwater and corresponding soil cleanup goals for the respective volatile organic contaminants of concern. This section presents the cleanup goals and the residual site risks associated with these target levels. A detailed discussion of the basis for selection of the cleanup goals is presented below in Section X.B. These contaminant-specific cleanup goals are presented in Table VI-3.

For the carcinogenic contaminants of concern the groundwater cleanup goals are based on maximum contaminant levels (MCLs) or, in their absence, on an excess cancer risk level of 10^{-6}. MCLs are considered relevant and appropriate in the cleanup of this aquifer as they are drinking water standards.

The cumulative cancer risk level posed by these contaminants in groundwater at their target cleanup levels is $2.6x10^{-4}$. Most of this risk can be attributed to vinyl chloride and 1,1 dichloroethylene. Since both of these compounds have relatively high vapor pressures and Henry's Law constants, they are expected to be very conducive to removal from soil by vacuum extraction and from groundwater by aeration. In achieving the target levels for the other VOCs, these compounds are anticipated to be removed to below detection levels, thus resulting in a residual risk less than $2.6x10^{-4}$.

For the noncarcinogenic contaminants of concern the cleanup goals for groundwater were also based on drinking water standards (MCLs/MCLGs). Each of these contaminants at their target cleanup level does not exceed a hazard index of 1 nor do the hazard indices of compounds with similar target endpoints add up to a value greater than 1.

Groundwater cleanup goals shall be achieved everywhere on the Valley Site at every point in the aquifer. This is based on the aquifer classification as a current or potential drinking water supply.

Soil cleanup goals are to be achieved everywhere on the Valley Site unless it is determined that a contaminant level in soil has been achieved that is not contributing to groundwater contamination above cleanup goals.

Soil cleanup goals have been set for volatile organic compounds in order to prevent the leaching of contamination from the soil into groundwater. Target level concentrations in soil were based on the application of the soil/water equilibrium calculation presented in Section 2.0 of the Feasibility Study.

As discussed above in Section IV(6), the selected remedial action will also attain, with respect to inorganic contamination, the applicable or relevant and appropriate requirements of the: Massachusetts Ground Water Quality Standards (314 CMR §6.00) and Ground Water Discharge Permit Program (314 CMR §5,00), Safe Drinking Water Act, and RCRA groundwater protection standards (40 CFR Part 264.92). A determination as to whether these requirements and other general standards of protectiveness have been met will be made at the five-year statutory review, at completion of the selected remedy or at some earlier time. These applicable or relevant and appropriate standards, criteria and limitations are presented in Table VI-4.

VII. DOCUMENTATION OF SIGNIFICANT CHANGES

EPA published a Proposed Plan (soil vapor vacuum extraction/high-rate groundwater treatment) for remediation of the Valley Site on July 20, 1988. The Proposed Plan also summarized the contamination detected in the RI and established the general remedial action objectives and cleanup goals for the Valley Site contamination. The preferred alternative presented in the Proposed Plan included soil vapor vacuum extraction (VES) and a high-rate of groundwater extraction and treatment with aeration and carbon adsorption for volatile organics remediation. Pretreatment of groundwater for inorganics was also presented in the preferred alternative. The FS, which was released to the public on August 4, 1988, thus starting the formal 21-day public comment period, presented contaminant-specific target groundwater cleanup levels and corresponding residual target soil cleanup levels, and evaluated remedial alternatives for volatile organics contamination in soil and groundwater.

In an August 17, 1988 letter to the PRPs, the Town of Groveland and other interested parties, EPA clarified certain aspects of the Proposed Plan. This letter:

- corrected certain tables in the FS relating to organic contamination in soil and groundwater;
- proposed certain cleanup levels for inorganics in groundwater; and,
- clarified that EPA's preferred alternative included removal or decontamination of septic disposal systems; further evaluation of the release of hazardous substances from the storage tanks; a determination of the extent of inorganic contamination and an evaluation of in-situ treatment alternatives regarding inorganic contamination.

The remedy selected in this ROD contains all elements of the alternative presented in the July 20, 1988 Proposed Plan. It does not formally select the inorganic remedy; rather it adopts the inorganic cleanup goals proposed in the August 17, 1988 clarification as a benchmark to determine whether the inorganic treatment originally presented in the Proposed Plan as an integral part of the organic groundwater remedy will incidentally attain a level of inorganic cleanup that attains ARARs and is protective of human health and the environment.

TABLE VI-3
VALLEY SITE SOURCE-CONTROL CONTAMINANT-SPECIFIC CLEANUP GOALS

COMPOUND	CONCENTRATION		BASIS	CARCINOGENIC RISK LEVEL(6)
	GROUNDWATER (ug/l)	SOIL(5) (ug/kg)		
	(parts per billion)			
Carcinogens--				
trichloroethylene	5	6.3	MCL(1)	1.6x10^{-6}
vinyl chloride	2	1.14	MCL(1)	1.3x10^{-4}
methylene chloride	5	0.44	10^{-6}(2)	1.0x10^{-6}
tetrachloroethylene	5	18.2	(3)	7.3x10^{-6}
1,1 dichloroethylene	7	4.6	MCL(1)	1.2x10^{-4}
TOTAL				2.6x10^{-4}
				NONCARCINOGENIC HAZARD INDEX(6)
Noncarcinogens--				
trans 1,2 dichloroethylene	70	41.3	MCLG(4)	0.2
toluene	2000	6000.0	MCLG(4)	0.2
1,1,1 trichloroethane	200	302.0	MCL(1)	0.07

Notes:
1. MCL - Maximum Contaminant Level, Safe Drinking Water Act Amendments, 1986.
2. In the absence of any promulgated drinking water standard, the target level is based on 10^{-6} excess cancer risk level.
3. Based on the similarities in structure, potency and toxicity between PCE and TCE, the MCL for TCE was the basis for the level for PCE.
4. MCLG - Maximum Contaminant Level Goal (Proposed in the Federal Register, November 13, 1985).
5. Maximum soil concentration when in equilibrium with the groundwater target level. See Section X.B.
6. Incremental carcinogenic risk level and noncarcinogenic hazard index for groundwater.

TABLE VI-4
VALLEY SITE SOURCE-CONTROL REMEDIATION GROUND WATER QUALITY STANDARDS AND DISCHARGE STANDARDS

COMPOUND	CONCENTRATION (mg/l)	BASIS
arsenic	0.05	(1), (2)
chromium	0.05	(1), (2)
cadmium	0.01	(1), (2)
lead	0.05	(1), (2)
copper	1.0	(1), (3)
zinc	5.0	(1), (3)
mercury	0.002	(1), (2)
oil and grease	15.0	(1), (3)
iron	0.3	(1), (3)

Notes:

1. Ground Water Quality Standards, 314 CMR §6.06 (12/31/86) are applicable to Class I aquifers.
2. Primary effluent limitations for Class I and Class II ground waters, 314 CMR §5.10(3)(a) (12/31/86) are applicable to ground water discharges.
3. Secondary effluent limitations for Class I and Class II ground waters, 314 CMR §5.10(3)(b) (12/31/86) are applicable to ground water discharges.

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The remedy selected in this ROD does not address removal or decontamination of the septic disposal systems or the immediate evaluation of in-situ inorganic treatment alternatives. The inorganic remedy for the site, if any, will be formally selected in a subsequent decision document.

The remedy selected does not contain any significant changes from the Proposed Plan. All interested parties have been given adequate opportunity to comment on EPA's proposed remedy.

VIII. DEVELOPMENT AND SCREENING OF ALTERNATIVES

A. Statutory Requirements/Response Objectives

Prior to the passage of the Superfund Amendments and Reauthorization Act of 1986 (SARA), actions taken in response to releases of hazardous substances were conducted in accordance with CERCLA as enacted in 1980 and the revised National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR Part 300, dated November 20, 1985. Until the NCP is revised to reflect SARA, the procedures and standards for responding to releases of hazardous substances, pollutants and contaminants shall be in accordance with Section 121 of CERCLA and to the maximum extent practicable, the current NCP.

Under its legal authorities, EPA's primary responsibility at Superfund sites is to undertake remedial actions that are protective of human health and the environment. In addition, Section 121 of CERCLA establishes several other statutory requirements and preferences, including: a requirement that EPA's remedial action, when complete, must comply with applicable or relevant and appropriate environmental standards established under federal and state environmental laws unless a statutory waiver is warranted and justified in a ROD; a requirement that EPA select a remedial action that is cost-effective and that utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and a statutory preference for remedies that permanently and significantly reduce the volume, toxicity or mobility of hazardous wastes over remedies that do not achieve such results through treatment. Response alternatives were developed to be consistent with these Congressional mandates.

A number of potential exposure pathways were analyzed for risk and threats to human health and the environment in the Endangerment Assessment. Guidelines in the Superfund Public Health Evaluation Manual (EPA, 1986) regarding development of design goals and risk analyses for remedial alternatives were used to assist EPA in the development of response actions. As a result of these assessments, remedial response objectives were developed to mitigate existing and future threats to human health and the environment. These response objectives for organic and inorganic contaminants are to:

(1) Prevent ingestion of groundwater contaminated in excess of relevant and appropriate drinking water standards (MCLs/MCLGs) or, in their absence, an excess cancer risk level of 10^{-6}, for each carcinogenic compound. Also, to prevent ingestion of groundwater contaminated in excess of a total excess cancer risk level for all carcinogenic compounds of 10^{-4} to 10^{-7};

(2) Prevent ingestion of groundwater contaminated in excess of relevant and appropriate drinking water standards for each noncarcinogenic compound and a total Hazard Index greater than unity (1) for all noncarcinogenic compounds;

(3) Prevent migration of contaminants in soils and groundwater that would result in groundwater contamination in excess of relevant and appropriate drinking water standards and surface water contamination in excess of relevant and appropriate ambient water quality criteria for the protection of aquatic life; and,

(4) Remediate inorganic contamination to the extent that such remediation is incidental to organics remediation, and to evaluate attainment of the applicable or relevant and appropriate requirements of Federal and State environmental regulations.

The groundwater and soil cleanup goals to achieve objectives (1), (2) and (3) are presented above in Section VI and below in Section VIII.C. The applicable or relevant and appropriate standards, criteria and limitations to achieve objective (4) are presented above in Section VI and below in Section XI.B.

B. Technology and Alternative Development and Screening

CERCLA, the NCP, and EPA guidance documents including, "Guidance on Feasibility Studies Under CERCLA" dated June 1985, and the "Interim Guidance on Superfund Selection of Remedy" [EPA Office of Solid Waste and Emergency Response (OSWER)], Directive No. 9355.0-19 (December 24, 1986) set forth the process by which remedial actions are evaluated and selected. In accordance with these requirements and guidance documents, treatment alternatives were developed for the site ranging from an alternative that, to the degree possible, would eliminate the need for long-term management (including monitoring) at the site to alternatives involving treatment that would reduce the mobility, toxicity, or volume of the hazardous substances as their principal element. In addition to the range of treatment alternatives, a containment option involving little or no treatment and a no-action alternative were developed in accordance with Section 121 of CERCLA.

Section 121(b)(1) of CERCLA presents several factors that at a minimum EPA is required to consider in its assessment of alternatives. In addition to these factors and the other statutory directives of Section 121, the evaluation and selection process was guided by the EPA document "Additional Interim Guidance for FY '87 Records of Decision" dated July 24, 1987. This document provides direction on the consideration of SARA cleanup standards and sets forth nine factors that EPA should consider in its evaluation and selection of remedial actions. The nine factors are:

1. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs).
2. Long-term Effectiveness and Permanence.
3. Reduction of Toxicity, Mobility or Volume.
4. Short-term Effectiveness.
5. Implementability.
6. Cost.
7. Overall Protection of Human Health and the Environment.
8. Community Acceptance.
9. State Acceptance.

In the Feasibility Study, Section 2, general response actions were identified (Table VIII-1) to achieve the remedial action objectives presented above in Section VIII.A. See Appendix E for Tables VIII-1 through VIII-14. Subsequently, in the FS Section 2, remedial action technology types and process options for potential volatile organic treatment technologies and their associated containment or disposal requirements were identified and screened for suitability as part of source-control remedial alternatives for soil (Table VIII-3) and groundwater (Table VIII-2). These technology types and process options were then combined in the FS Section 3 to develop media-specific alternatives involving treatment, containment and no-action (Tables VIII-4 and VIII-5).

In the FS, Section 3, the four groundwater alternatives and eight soil alternatives presented in Tables VIII-4 and VIII-5 were developed and screened against effectiveness, implementability and cost. The purpose of the initial screening was to narrow the number of alternatives for further analysis while preserving a range of options (Tables VIII-6 and VIII-7).

After this initial screening, the groundwater and soil alternatives were combined into comprehensive source-control remedial alternatives addressing both soil and groundwater. The treatment alternatives developed ranged from alternatives that would eliminate the need for long-term management to alternatives involving treatment that would permanently reduce toxicity, mobility or volume as their principal element.

In summary, from the four groundwater and eight soil alternatives presented in the FS, Section 3.3, six comprehensive source-control alternatives were developed and retained for detailed analysis in Section 4.

These six comprehensive source-control alternatives for volatile organics remediation are presented in Table VIII-8. The evaluation of these six alternatives with respect to the first seven factors listed above is presented in Tables VIII-9 through VIII-14.

C. Cleanup Goals

Cleanup goals for soil and groundwater at the Valley Site have been established for volatile organic compounds based upon the baseline risk assessment, (Section VI), the groundwater classification (Section V.D) and an analysis of applicable or relevant and appropriate requirements of Federal and State environmental regulations. These cleanup goals are presented above in Table VI-3. A discussion of the rationale for selection of the groundwater and soil cleanup goals and the point of compliance for remedial action is presented below at Section X.B.

Each alternative presented in the detailed analyses of the FS was evaluated for its capability in achieving the contaminant-specific cleanup levels.

IX. DESCRIPTION/SUMMARY OF THE DETAILED AND COMPARATIVE ANALYSIS OF SOURCE-CONTROL ALTERNATIVES

This section presents a narrative summary and brief evaluation of each alternative according to the evaluation criteria described above. A detailed tabular assessment of each alternative can be found in Table 4-7 of the Feasibility Study and Table IX-1 below.

The source-control alternatives analyzed for the Valley Site include a minimal no action alternative (SC-1); in-situ soil treatment alternatives (SC-2, SC-3); onsite above ground soil treatment alternatives (SC-4, SC-5); and, an offsite soil treatment/disposal alternative (SC-6). Alternatives SC-2, SC-4 and SC-6 also include a high-rate (10 years) groundwater treatment system, while alternatives SC-3 and SC-5 include a low-rate (>30 years) groundwater treatment system. These alternatives are described briefly below with approximate capital and present worth of operation and maintenance costs.

SC-1
Minimal No Action

The no action alternative for the Valley Site would not involve any treatment or disposal of contaminated soil or groundwater. Instead, additional fencing would be erected and warning signs would be posted around the Valley property to prevent direct contact with contaminated soil. Deed restrictions also would be placed on the Property to restrict future property development and groundwater use. Additional groundwater monitoring wells would be installed to permit sampling of groundwater in the overburden and bedrock, both upgradient and downgradient of the Valley Site.

Groundwater samples would be collected from selected wells on- and off-site every three months until it was demonstrated that the site no longer presented a threat to human health and the environment.

Because this alternative would not involve disturbing the contaminated soil, other than to construct the fence, it provides short-term effectiveness in protecting public health during implementation. However, this alternative would require ongoing surveillance and maintenance to ensure long-term effectiveness. Institutional controls such as fencing and deed restrictions are not considered reliable or effective at reducing/eliminating risks from groundwater ingestion and dermal contact with or ingestion of soils in the long-term. This alternative would not reduce the toxicity, mobility, or volume of the contaminants, nor would it comply with ARARs.

Estimated Time for construction and Operation: > 30 years
Estimated Capital Cost: $76,000
Estimated Operation and Maintenance Cost: $630,000

SC-2
Vacuum Extraction/High Rate Groundwater Treatment
This alternative is the selected remedial alternative for volatile organics remediation and is described below as presented in the FS. This remedy is further described in Section X.A, Selected Remedy.

Vacuum Extraction
The soil vapor vacuum extraction system (VES) is an alternative in-situ soil treatment technology utilizing vadose (unsaturated) zone extraction wells, vacuum pumps, associated piping and vapor treatment. With the VES process, a subsurface vacuum is developed in order to induce air and contaminant flow through the soil matrix to the extraction wells, where contaminated vapor is withdrawn. Volatile organic contaminants are essentially air-stripped from the soils due to the mass transfer of contaminants to the soil vapor.

This facilitates soil treatment in-situ,or without excavation. Moisture is removed from the contaminated soil vapor in a condenser or separator. Vapors are then drawn through activated carbon beds where volatile organic contaminants are adsorbed before discharging the clean air to the atmosphere. The separated water will be treated on-site via carbon adsorption and then discharged to the ground downgradient of the site. To measure the effectiveness of the vacuum extraction system, monitoring of wellhead and process gases and emissions would be conducted throughout the period of operation. See Figure 9 and 10.

This remedy is expected to require relatively little time to implement as fourteen extraction wells at seven locations, each consisting of one shallow well screened above the clay strata and one deep well screened below the clay strata, have already been installed and developed at the site under the SITE Program demonstration project and the Consent Order Modification. Soil gas monitoring wells have also been installed at the site. The extraction and monitoring wells, which are depicted in Figure 6-1, are piped/connected to a VES similar to that installed for the Consent Order Modification treatability study. Capital costs include costs for additional extraction wells, vapor collection header piping, blowers and associated valves, electrical fixtures, condensers and carbon canisters. Operation and maintenance costs include replacement/regeneration of spent carbon, lubrication and belts, manpower costs and other annual costs such as insurance, security and administration. Additional soil and wellhead and process gas sampling are included in this estimate to further define existing soil contamination and to provide documentation for system performance. Table XI-1 presents these capital and operating and maintenance costs and the total present worth cost for this alternative. The groundwater component of this selected remedy consists of air stripping, filtration, carbon adsorption and discharge back to ground water.

This technology would protect human health and the environment in both the long- and short-term and provide permanent treatment of the soil and reduction of contaminant volume. The vacuum extraction system would also provide compliance with Federal and State applicable or relevant and appropriate requirements (ARARs). Because the vacuum extraction system is an in-situ process and does not require excavation or removal of contaminated soil, it would be less difficult to implement and would pose no risk of exposure to contaminants during treatment, unlike the other soil treatment alternatives evaluated in the FS.

The results of the SITE Program vacuum extraction pilot study conducted at the site and the soil treatability study performed by Valley/GRC in 1988 under the Consent Order Modification would be used to aid in the design of a full-scale system for the site.

The vacuum extraction system will be operated until the soil cleanup goals are attained everywhere on the Valley Site, as determined by subsurface soil and soil gas sampling and analysis. The system's performance will be evaluated in the five-year statutory remedy review or at some earlier time as the soil cleanup goals are attained or determined to be unattainable.
The area of attainment for the soil cleanup goals is to be achieved everywhere on the Valley Site unless it is determined that a contaminant level in soil has been achieved that is not contributing to groundwater contamination above cleanup goals.

Estimated Time for Construction and Operation: <10 years
Estimated Capital Cost: $702,000
Estimated Total Operation and Maintenance Cost: $1,147,000

High Rate Groundwater Recovery and Treatment
Air stripping combined with carbon treatment would be used to address groundwater contamination at the Valley Site. This approach would require installation of a well system to pump contaminated groundwater at the Site. Groundwater would be extracted at a high rate (approximately 30 gallons per minute (gpm)is anticipated). Optimum recovery rates will be developed through on-site pump tests and other studies conducted during remedial design. The extracted groundwater would be pretreated to remove inorganic compounds and then passed through an air stripping chamber to remove VOCs. In the chamber, air would be forced over the water, causing contaminants to volatilize from the water into the air. The air would then be treated in activated carbon columns to remove contaminants before being discharged to the atmosphere. A portion of the groundwater that passes through the air stripper (approximately 1.5 gpm of the total 30 gpm) would be filtered through activated carbon columns to remove residual contaminants and then discharged to a point downgradient of the site. The remainder of the treated groundwater would be circulated back through the extraction zone and recaptured for further treatment. This alternative would continually pump and treat groundwater until cleanup goals are attained. (Figure 8 illustrates the preferred groundwater treatment process). Incoming groundwater and emissions from the system would be monitored throughout operation.

Air stripping and carbon adsorption are proven technologies for the removal of VOCs of the type that have been found at the site. The combined system would bring rapid improvement in the groundwater quality. This technology, like vacuum extraction, would protect human health and the environment in both the long- and short-term, comply with ARARs, and permanently reduce the volume of site contamination.

The area of attainment for the groundwater cleanup goals shall be achieved everywhere on the Valley Site at every point in the

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aquifer. This is based on the aquifer classification as a current or potential drinking water supply.

Estimated Time for Construction and Operation: ≤10 years
Estimated Capital Cost: $786,000
Estimated Total Operation and Maintenance Cost: $1,530,000

SC-3
Vacuum Extraction/Low Rate Groundwater Treatment
This alternative would use the same vacuum extraction system as the preferred alternative to treat contaminated soil. It also would require extraction and treatment of groundwater, but at a much slower rate (1.5 gpm rather than 30 gpm). This alternative does not include recirculation of groundwater back through the extraction zone, as called for in the preferred alternative. Instead, all groundwater treated in the facility would be discharged downgradient of the site. This alternative meets the evaluation criteria in the same way as the preferred alternative, except that it has a lower short-term effectiveness (ability to reduce potential exposure to contaminants during implementation) and a higher total operation and maintenance cost due to the extended period of operation.

This alternative was not selected due to the length of time required to achieve the groundwater cleanup goals and high present worth operation and maintenance costs.

Estimated time for Construction and Operation: <10 years (soil); 30 years minimum (groundwater)
Estimated Capital Cost: $1,300,000
Estimated Total Operation and Maintenance Cost: $3,600,000

SC-4
Low-temperature Thermal Stripping/High-Rate Groundwater Treatment

This alternative would entail the use of the same groundwater treatment component as the preferred alternative. For this alternative, contaminated soil would be excavated and treated to remove VOCs on-site in a mobile treatment unit. In a low-temperature thermal stripping process, VOC-contaminated soil is placed inside the treatment unit and heated. Air is forced through the soil to transfer VOCs from the soil to the air. The air is then passed through a series of pollution control devices to destroy or remove the contaminants before it is released to the atmosphere. For this alternative, the FS estimates that approximately 19,000 cubic yards of contaminated soil would require excavation and treatment. As part of this alternative, approximately fifteen percent of the Valley manufacturing building would have to be demolished in order to remove contaminated soils located underneath the facility. Treated soils would be tested to

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ensure that cleanup level goals have been achieved. Adequately treated soils would then be backfilled to the excavated areas, or treated again, as appropriate.

This alternative would provide long-term protection of human health and the environment, compliance with ARARs, and permanent reduction of the volume of site contaminants. However, the alternative is not an in-situ remedy and requires excavation, stockpiling, and handling of contaminated soils, thereby increasing the potential exposure to workers, employees, and local residents. Actions would be required to control and minimize any short-term threats to human health and the environment from releases of VOCs into the ambient air during excavation. In addition, pilot studies to finalize the system design and operating procedures would be required prior to implementation of remedial actions. Based on the cost, time to implement and short-term adverse impacts associated with this remedy as well as community and state opposition, this remedy was not selected.

Estimated Time for Construction and Operation: 2-3 years (soil); 10 years (groundwater)
Estimated Capital Cost: $7,170,000
Estimated Total Operation and Maintenance Cost: $1,600,000

SC-5
Low-Temperature Thermal Stripping/Low-Rate Groundwater Treatment

This alternative combines the soil treatment component described above under alternative #4, and the groundwater treatment component described under alternative #3. Overall, this alternative would provide a high level of protection of public health and the environment, compliance with ARARs, and permanent reduction of the volume of site contaminants. This remedy was not selected for similar reasons as SC-4 plus the time to achieve the cleanup goals for groundwater.

Estimated Time for Construction and Operation: 2-3 years (soil); 10 years (groundwater)
Estimated Capital Cost: $7,016,000
Estimated Total Operation and Maintenance Cost: $2,600,000

SC-6
Off-site Disposal/High-Rate Groundwater Treatment

This alternative would entail the use of the same groundwater treatment system as the preferred alternative. For the soil component of this alternative, approximately 19,000 cubic yards of contaminated soil at the site would be excavated and transported off-site for treatment and disposal at a permitted hazardous waste facility. Excavation and transportation of contaminated soil would be controlled to minimize any short-term threat to human health and the environment from contaminant emissions during the remedial action. To implement this alternative, approximately fifteen percent of the Valley building would have to be demolished in order to remove contaminated soil.

This alternative provides a long-term protection of human health and the environment, compliance with ARARs, and permanent reduction of the toxicity, mobility, and volume of site contaminants but requires disposal off-site. This is not considered to be consistent with the intent of CERCLA to reduce toxicity, mobility or volume. Implementation of this alternative may be difficult, however, because extensive measures would need to be taken to ensure protection of public health during excavation and transport of contaminated soil, and because there are currently no permitted hazardous waste treatment facilities near the site.

Estimated Time for Construction and Operation: 1 year (soil); 10 years (groundwater)
Estimated Capital Cost: $18,000,000
Estimated Total Operation and Maintenance Cost: $1,500,000

X. THE SELECTED SOURCE-CONTROL REMEDY

The source-control remedial action selected for implementation at the Valley Site is consistent with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and, to the extent practicable, the National Oil and Hazardous Material Contingency Plan (NCP) 40 CFR Part 300 et seq., 47 Federal Register 31180 (July 16, 1982) as amended. The selected remedial action is a comprehensive source-control operable unit of the Valley Site section of the Groveland Wells Nos. 1 & 2 Superfund Site for organic contamination which addresses both soil and groundwater contamination to achieve the response objectives and cleanup goals established for the Valley Site remediation and governing legal requirements.

A. Description of the Selected Remedy

(1) Design, install, operate and maintain a soil vapor vacuum extraction system (VES) in the vadose zone which will intercept laterally and vertically all areas of subsurface soil contamination so as to attain the soil cleanup goals presented in Table VI-3 in an efficient and expeditious manner.

The area of attainment for the soil cleanup goals everywhere on the Valley Site unless it is determined that a contaminant level in soil has been achieved that is not contributing to groundwater contamination above cleanup goals.

The VES will utilize the extraction and monitoring wells installed during the SITE program demonstration and the Consent Order Modification. Additional extraction and monitoring wells will be installed as necessary. It is anticipated that four to six additional extraction/ monitoring wells will be installed. Design of the VES to be implemented will be based on evaluation of the results of the SITE Program demonstration and the Consent Order Modification treatability study.

The VES will utilize carbon adsorption for vapor treatment. Carbon adsorption or equivalent treatment will also be utilized for the treatment of separator water before being discharged downgradient of the site. This contaminated water may be treated in the groundwater treatment system described above in alternative SC-2 and below in (3).

An adequate and effective sampling and analysis program will be designed and implemented to monitor the performance of the VES recovery and treatment and process gas discharges. It is currently estimated that the soil cleanup goals can be achieved within 10 years.

(2) Design, install, operate and maintain a groundwater recovery/recirculation system in overburden and bedrock. This system will intercept contaminated groundwater on the site in all downgradient directions (east and south) and recirculate a portion of treated effluent upgradient of the site to accelerate removal of saturated zone soil contamination.

Recovery/recirculation shall be at high rates that will attain the groundwater cleanup goals established in Section VIII.C and presented in Table VI-3 in an efficient and expeditious manner. As part of design, groundwater recovery and recharge pilot studies will be performed.

It is currently estimated that the groundwater cleanup goals can be achieved within 10 years.

The area of attainment for the groundwater cleanup goals shall be achieved everywhere on the Valley Site at every point in the aquifer. This is based on the aquifer classification as a current or potential drinking water supply.

(3) Design, install, operate and maintain a groundwater treatment system utilizing aeration and carbon adsorption to treat the contaminated groundwater from the recovery system implemented in accordance with (2).

It is anticipated that the portion of the effluent to be recirculated upgradient of the site within the zone of influence of recovery will be treated by aeration alone. The portion of the effluent to be discharged downgradient and outside of the zone of influence of recovery will be treated by aeration and carbon adsorption to meet the discharge standards established in the Massachusetts Ground Water Discharge Permit Program (314 CMR §5.00).

Carbon adsorption will be utilized for treatment of emissions from the aeration treatment to comply with the Massachusetts Air Pollution Control requirement to utilize Best Demonstrated Available Technology for point source emissions (310 CMR §7.00).

Incidental treatment for inorganic compounds and secondary effluent parameters will be utilized as necessary to efficiently operate the treatment system for removal of VOCs and to meet the discharge standards of 314 CMR §5.00, which are presented in Table VI-4.

An adequate and effective sampling and analysis program will be designed and implemented to monitor the performance of the groundwater recovery/recirculation and treatment system and discharge effluent.

The design of the groundwater recovery/recirculation and treatment system will consider the groundwater treatability study performed under the Consent Order Modification.

(4) Effectively seal or disconnect all drains and lines to the Brite-dip subsurface disposal system.

The area of attainment for the groundwater cleanup goals is everywhere on the property in the saturated zone, and for the soil cleanup goals, everywhere in the vadose zone.

While not a part of the selected remedy, it is anticipated that EPA will review closure of the underground storage tanks under the UST program and closure of the septic systems under RCRA.

B. Rationale for Selection/Cleanup Goals

The rationale for choosing the selected alternative is based on the assessment of each criteria listed in the evaluation of alternatives section of this document. In accordance with Section 121 of CERCLA, to be considered as a candidate for selection in the ROD, the alternative must have been found to be protective of human health and the environment and able to attain ARARs unless a waiver is granted. In assessing the alternatives that met these statutory requirements, EPA focused on the other evaluation criteria, including, short term effectiveness, long term effectiveness, implementability, use of treatment to permanently reduce the mobility, toxicity and volume, and cost, EPA also considered nontechnical factors that affect the implementability of a remedy, such as state and community acceptance. Based upon this assessment, taking into account the statutory preferences of CERCLA, EPA selected the remedial approach for the Site.

This source control remedial action is designed primarily to address the organic contamination in unsaturated and saturated subsurface soils and groundwater. The target groundwater and corresponding soil cleanup levels are presented in Table VI-3 and discussed below.

EPA has determined that while in the long-term, alternatives involving excavation of contaminated unsaturated soils and on-site above-ground treatment via low temperature thermal stripping (LTTS) (SC-4 and SC-5) and those involving in-situ removal of contaminants from unsaturated soils by a vacuum extraction system (VES) and treatment of extracted vapor via carbon adsorption (SC-2 and SC-3), provide a similar degree of protection, those involving excavation and above-ground treatment have significant potential short-term adverse effects associated with their implementation: threat of volatile contaminant emissions during excavation and treatment processing; threat of exposure to contaminants during handling; disruption to site and surrounding community; long lead time from selection to implementation due to need for pilot studies/design and site preparation.

In addition, the limited area on the Valley site poses potential institutional/implementability issues related to staging of excavation and treatment equipment and the stockpiling treated soils before backfilling to the excavation area.

The selected in-situ vacuum extraction: provides the same degree of contaminant removal and permanency, few or no adverse short-term impacts, no site or community disruption, no excavation or handling of contaminated soils. Further, in-situ vacuum extraction has been demonstrated to be effective on this site and will require relatively little time to implement with substantial contaminant reduction realized immediately.

Groundwater

The target groundwater cleanup levels are primarily based upon the classification of the groundwater at the Valley Site as a current or potential source of drinking water to which Maximum Contaminant Levels promulgated under the Safe Drinking Water Act are relevant and appropriate. The groundwater protection standards under RCRA Subpart F are also relevant and appropriate requirements. The target groundwater levels have been set at MCLs or, in their absence, an excess cancer risk level of 10^{-6} (as is the case with

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methylene chloride). As the legally enforceable standards under the Safe Drinking Water Act, MCLs determine the level of water quality that is acceptable for public supplies.

With respect to groundwater remediation, EPA evaluated two rates of groundwater restoration: low-rate involving removal and treatment of contaminated groundwater at the rate of natural flow through the site; and, high-rate which accelerates contaminant removal from the saturated zone by artificially recharging treated groundwater upgradient. Both options utilize aeration/carbon adsorption for treatment.

While both rates of groundwater restoration provide the same degree of long-term protection and will attain ARARs, the low-rate would require substantially longer than 30 years to achieve the cleanup goals while a high-rate system would require an estimated 10 years to achieve those goals, at a lower total cost for capital and present worth of operation and maintenance, due to the shorter period of operation. Capital costs for both low- and high-rate groundwater recovery/treatment system are nearly equal at $1.3 and $1.5 million, respectively.

The Agency's decision to restore the groundwater at the Site to drinking water standards was based on several factors. In addition to the requirement to attain Federal and State ARARs, the Agency considered its Groundwater Protection Strategy (GWPS) (Office of Groundwater Protection, August, 1984) which provides guidance concerning how different groundwaters throughout the country should be classified and to what extent cleaning up a particular class of groundwater is appropriate. EPA also considered the Agency's draft Guidance on Remedial Actions for Contaminated Groundwater at Superfund Sites (October, 1986). This guidance directs the Agency to consider a 10^{-4} to 10^{-7} range of risk levels in selecting the appropriate risk level for the groundwater at the Site.

The policy under the GWPS establishes groundwater protection goals based on "the highest beneficial uses to which groundwater having significant water resources value can presently or potentially be put." Guidelines for protection of aquifers are differentially based, relative to characteristics of vulnerability, use and value.

Under the classification scheme, the groundwater at the Valley Site is Class II groundwater. This groundwater is considered to be a current drinking water source since groundwater is used for drinking water within a two-mile radius of the Site (the classification review area).

EPA believes that active restoration of the groundwater is appropriate for the Site. Presently, the Town obtains groundwater from the overburden aquifer system. Contamination in the overburden and bedrock aquifers has been detected at substantial levels beyond the Valley Site boundaries.

Finally, it is reasonable to assume that development could occur on or near the Site following remediation. As mentioned previously, source soils will be remediated to levels that are protective of human health and the environment.

Consistent with the draft Guidance on Remedial Actions for Contaminated Groundwater at Superfund Sites and EPA's Superfund Public Health Evaluation Manual, EPA evaluated a risk range of 10^{-4} to 10^{-7} individual lifetime cancer risks for carcinogens in selecting a risk level for groundwater. In selecting the appropriate risk level for the Site and the rate of restoration, EPA considered the following major factors:

1. Site and groundwater characteristics;
2. Cost, reliability, speed, and technical feasibility of groundwater response actions;
3. Anticipated future need for the groundwater;
4. Potential for spreading of the contaminant plume; and,
5. Effectiveness and reliability of institutional controls.

MCLs were selected as target cleanup levels for vinyl chloride, trichloroethylene, and 1,1-dichloroethylene, as established under the Safe Drinking Water Act. A standard for tetrachloroethylene has not yet been developed. It is, however, similar in chemical, physical, and toxicological properties to trichloroethylene and therefore the same cleanup level of 5 ppb has been adopted. A value of 5 ppb for methylene chloride, corresponding to a $1x10^{-6}$ excess cancer risk level, was also adopted.

An incremental lifetime cancer risk of 2.6×10^{-4} associated with the ingestion of the five volatile organic contaminants of concern at their respective target cleanup levels is considered by EPA to be adequately protective of public health under the specific conditions related to this Site. EPA anticipates continued growth within the Town of Groveland, thus increasing the demand placed on the Johnson Creek aquifer and Municipal Well Station No. 1. EPA rejected target risk levels significantly lower than $2.6x10^{-4}$ due to the technical and economic feasibility of remediating groundwater.

Soil

The target soil cleanup levels presented in Table VI-3 are based on achieving the target groundwater levels. This approach utilizes a soil/water sorption coefficient which describes the distribution of an indicator chemical between soil and groundwater at equilibrium. The amount of naturally occurring organic carbon present in soils has a large impact on the amount of contamination that will be attenuated in those soils and therefore unable to migrate and contribute to further groundwater contamination.

Typically, glacial soils contain small amounts of organic carbon, roughly one-half to five percent. Clay content and iron oxide content of soils have been shown to significantly increase the adsorptive capacity of soils. Some soils at the Valley Site have large amounts of clay material but others are relatively porous sands and gravels. Although there have been no tests performed to determine the fraction of organic carbon in the soils at the Valley Site a value of 1% was assumed based on the soil types present. The equation used to calculate the soil cleanup target levels is provided in the FS in Section 2.

XI. STATUTORY DETERMINATIONS

The remedial action selected for implementation at the Valley Site is consistent with CERCLA and, to the extent practicable, the NCP. The selected remedy is protective of human health and the environment, attains ARARs and is cost effective. The selected remedy also satisfies the statutory preference for a permanent solution and for treatment which reduces the mobility, toxicity or volume as a principal element to the maximum extent practicable. Additionally, the selected remedy utilizes alternate treatment technologies to the maximum extent practicable.

A. The Selected Remedy is Protective of Human Health and the Environment

The source-control remedy for the Valley Site will significantly reduce the current and potential risks to human health and the environment posed by contaminated groundwater and subsurface soils. This source control remedy will reduce and minimize the migration of groundwater contamination from the Valley Site. The Valley Site contributes to significant contamination off site in the Mill Pond/Johnson Creek watershed and aquifer. Upon successful implementation of this remedy, the relevant and appropriate drinking water standards established under the Safe Drinking Water Act and other health based groundwater cleanup goals for the selected volatile organic contaminants of concern will be achieved everywhere on the Valley Site.

The incremental lifetime cancer risk level posed by the ingestion of residual volatile organic contaminants of concern in groundwater is not expected to exceed 2.6×10^{-4}. The noncarcinogenic health effects posed by ingestion of the volatile organic contaminants of concern in groundwater is not expected to exceed a hazard index of unity.

B. The Selected Remedy Attains ARARs

This remedy will meet or attain all applicable or relevant and appropriate federal and state environmental requirements that apply to the site. Federal environmental laws and regulations which are applicable or relevant and appropriate to the selected remedial action at the Valley Site are certain provisions of the:

Resource Conservation and Recovery Act (RCRA)
Safe Drinking Water Act (SDWA)
Clean Air Act (CAA)
Occupational Safety and Health Administration (OSHA) Regulations

Table C-1, taken from Appendix C of the Feasibility Study, lists the chemical-specific Federal and State ARARs, and outlines the actions which will be taken to attain these ARARs. No location-specific ARARs have been identified for the Valley Site. Table C-2 lists the action-specific Federal and State ARARs, presents a brief synopsis of the requirements, and outlines the action which will be taken to attain these ARARs. These tables also indicate whether an ARAR is determined to be applicable, relevant and appropriate or whether it is in the category of to-to-considered. A brief narrative summary of the ARARs follows.

The principal chemical-specific ARARs are the Maximum Contaminant Levels (MCLs) established in the Safe Drinking Water Act (40 CFR 141.1 - 141.16) and the Massachusetts Groundwater Quality Standards (MGQSs) (314 CMR 6.00), which have been determined to be relevant and appropriate to remediation of the site. Hence, the MCLs were used primarily to establish the groundwater cleanup goals for volatile organic contaminants. In addition, the Maximum Contaminant Level Goals (MCLGs) established in the SDWA and the EPA risk Reference Doses (RfDs), both of which have been determined to be in the category of To Be Considered, were used in the absence of MCLs in establishing site cleanup goals. The MGQSs are set at MCLs with the exception of iron and manganese.

With respect to action-specific ARARs, in accordance with The Massachusetts Air Pollution Control (310 CMR 7.00) regulations which are considered to be applicable to all point-source discharges of volatile organic compounds, Best Available Control Technology (BACT) will be utilized in the treatment of discharges from the groundwater aeration system and vacuum extraction system.

Discharges of treated water to groundwater, both upgradient of the site for recirculation and downgradient will meet the standards set forth in the Massachusetts Ground Water Discharge Permit Program (314 CMR 5.00) Which are established to meet the MGQSs. These regulations, which are applicable to all ground water discharges, require treatment to MCLs for inorganics or organics identified as primary parameters. Discharge limitations are also established for secondary parameters such as oil and grease, iron, manganese and zinc. These standards are required to be met for all discharges.

The temporary storage and transportation of spent activated carbon will also comply with provisions of RCRA.

All Occupational Safety and Health Administration requirements for health and safety during hazardous waste operations (29 CFR Part 1926) and general industry standards (29 CFR Part 1910) will be complied with during implementation of this remedy.

With respect to long-term groundwater monitoring, the RCRA Groundwater Protection requirements (40 CFR §264, Subpart F) have been determined to be relevant and appropriate for this site. A groundwater monitoring system will be implemented consistent with 40 CFR §264.100(d) to determine the effectiveness of the groundwater remediation system.

C. The Selected Remedial Action is Cost Effective

In evaluating the cost-effectiveness of source-control alternatives, EPA considered the total short- and long-term costs of all proposed alternatives, which include the capital costs and present worth costs of operation and maintenance for the entire period during which such activities will be required. The FS identified and evaluated in detail remedial alternatives for no-action, in-situ treatment, on-site above-ground treatment and off-site treatment. All the alternatives evaluated in the detailed analysis of the FS, with the exception of the no-action alternative, are protective of human health and the environment and upon completion will attain ARARs.

The only alternative that has a lower cost than the remedy selected was the no action alternative. Thus, the selected remedy is cost effective.

D. The Selected Remedy Utilizes Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable

Vacuum extraction is an alternative treatment technology which provides removal of the mass of volatile organic contamination in soil, thereby permanently and significantly reducing the toxicity, mobility and volume of contamination. The VOCs that are removed in the extracted soil vapor are adsorbed onto granular activated carbon, which when saturated is transported for off-site regeneration at a resource recovery facility. Contaminant reduction efficiencies of 99.999% have been achieved at other sites utilizing vacuum extraction.

The groundwater recovery/treatment portion of the selected remedy also provides permanent removal and reduction of the mass of volatile organic contaminants in groundwater through groundwater recovery and treatment via air stripping and carbon adsorption. As with the VES, the spent activated carbon from the air stripper emissions control and from the liquid phase after aeration will be transported off-site for regeneration at a resource recovery facility.

E. The Selected Remedy Satisfies the Preference for Treatment as a Principal Element

The principal elements of the selected source-control remedy are soil vapor vacuum extraction and treatment with carbon adsorption for unsaturated soil treatment and recovery/recirculation and treatment by aeration and carbon adsorption for groundwater and saturated soil treatment. These elements address all human health and environmental threats at the site resulting from organic contamination of subsurface soils and groundwater by removing the mass of contaminants via in-situ recovery.

XII. STATE ROLE

The Commonwealth of Massachusetts Department of Environmental Quality Engineering has reviewed the various alternatives and has indicated its support for the selected remedy. The State has also reviewed the Remedial Investigation, Endangerment Assessments and Feasibility Study to determine if the selected remedy is in compliance with applicable or relevant and appropriate State environmental laws and regulations. The Commonwealth of Massachusetts concurs with the selected remedy for the Valley Site. A copy of the declaration of concurrence is attached as Appendix C. In accordance with Section 104 of CERCLA, the Commonwealth of Massachusetts is responsible for 10 percent of the cost of the remedial action. In the case of the selected remedy, the Commonwealth's share is estimated at approximately $400,000.

APPENDIX A
RESPONSIVENESS SUMMARY

CDM
environmental engineers, scientists,
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September 26, 1988

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Regional Superfund Community Relations Coordinator
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Subject: Final Responsiveness Summary for the Public Comment Period on the Feasibility Study and Proposed Plan for the Valley Source Area at the Groveland Wells Superfund site in Groveland, Massachusetts.

Work Assignment No: 415-1L32.0

EPA Contract No: 68-01-6939

Document No: 270-CR2-EP-GMGW-1

Dear Mr. Gagne and Ms. James:

Camp Dresser & McKee, Inc. is pleased to deliver this final responsiveness summary for the public comment period on the Feasibility Study and Proposed Plan of the Valley Source area at the Groveland Wells Superfund site in Groveland, Massachusetts. This responsiveness summary summarizes comments received during the public comment period and provides EPA's responses to those comments.

If you have any questions or comments, please contact me or Richard Quateman, REM II Community Relations Specialist.

Very truly yours,

CAMP DRESSER & McKEE INC.

William R. Swanson, P.E.
REM II Regional Manager

PERFORMANCE OF REMEDIAL RESPONSE ACTIVITIES AT UNCONTROLLED HAZARDOUS WASTE SITES (REM II)

US EPA Contract No. 68-01-6939

FINAL RESPONSIVENESS SUMMARY FOR THE VALLEY SOURCE AREA AT THE GROVELAND WELLS SUPERFUND SITE GROVELAND, MASSACHUSETTS

DOCUMENT CONTROL NO.: 270-CR2-EP-GMGX-1

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Preface

The United States Environmental Protection Agency (EPA) held a public comment period from July 27, 1988 to August 26, 1988 to provide an opportunity for interested parties to comment on the August 1988 Feasibility Study (FS) and July 20, 1988 Proposed Plan for the Valley Manufactured Products Company, Inc. (Valley)/ Groveland Resources Corporation (GRC) site (the Valley site) at the Groveland Wells Superfund Site in Groveland, Massachusetts. In addition, EPA allowed the potentially responsible parties (PRPs) the opportunity to submit additional technical information relevant to the Proposed Plan until September 7, 1988. The FS examines and evaluates various source-control cleanup options, called remedial alternatives, for addressing contamination of soils and groundwater by volatile organic compounds (VOCs) at the Valley Site. The Proposed Plan presented EPA's preferred alternative for source-control remedial action for VOCs at the Valley Site.

The purpose of this responsiveness summary is to identify comments raised during the public comment period and provide EPA responses to the comments. EPA considered all of the comments summarized in this document before selecting a final source-control remedial alternative for the contamination at the Valley site in Groveland, Massachusetts.

This responsiveness summary is divided into the following sections:

I. Overview of Remedial Alternatives Considered in the Feasibility Study and Proposed Plan - This section briefly outlines the remedial alternatives evaluated in the FS and presented in the Proposed Plan, including EPA's preferred alternative: soil vapor vacuum extraction for removal/treatment of contaminants from soil, and high-rate groundwater recovery and treatment utilizing air-stripping followed by carbon adsorption for groundwater treatment.

II. Background on Community Involvement and Concerns - This section provides a brief history of community interests and concerns regarding the Groveland Wells and Valley site.

III. Summary of Comments Received and EPA Responses - This section summarizes comments received by EPA during the public comment period and provides EPA's responses. A summary of the comments received from the Potentially Responsible Parties (PRPs) and EPA's responses to them are included in this section. The PRP's detailed comments are included as Attachment C to this responsiveness summary.

IV. Remaining Concerns - This section describes issues that may continue to be of concern to the community during the design and implementation of EPA's selected remedy for the Valley Site. EPA will address these concerns during the Remedial Design and Remedial Action (RD/RA) phase of the cleanup process.

Attachment A - This attachment is a list of the community relations activities that EPA has conducted to date at the Valley Site.

Attachment B - Transcript of the August 9, 1988 Informal Public Hearing held in Groveland, Massachusetts.

Attachment C - This attachment contains the PRP's detailed comment document.

I. OVERVIEW OF REMEDIAL ALTERNATIVES CONSIDERED IN THE FEASIBILITY STUDY AND PROPOSED PLAN

Using the information gathered during the Remedial Investigation (RI) and Supplemental RI performed by Valley/GRC under a Consent Order with EPA, and the Endangerment Assessment (EA) developed by EPA, EPA identified several objectives for the cleanup of the Valley Site. The response objectives are to:

1) prevent ingestion of contaminated groundwater;

2) prevent direct contact and ingestion of contaminated soil;

3) prevent inhalation of contaminants in the air; and,

4) prevent migration of contaminants from the site that would cause groundwater contamination in excess of state and Federal drinking water standards.

To achieve these objectives, EPA identified cleanup goals for remedial action and identified, developed, and evaluated potential cleanup alternatives. The evaluation, or FS report, specifically describes the alternatives considered for addressing volatile organic contamination in groundwater and soil, as well as the criteria EPA used to narrow the list to six potential remedial alternatives. Each of these alternatives is described briefly below.

1. No Action. The no action alternative would entail implementing a groundwater sampling program, installing additional fencing and warning signs, and restricting further use of the site. No groundwater or soil treatment would be conducted.

2. Vacuum Extraction/High-Rate Groundwater Treatment (EPA's Preferred Alternative). This alternative will use vacuum extraction to remove contaminants from soils on the site. A series of wells will be installed above the groundwater table and connected to a pumping system to create a vacuum that extracts vapor from the soil. Volatile organic compounds (VOCs) present in the soil are drawn into the vapor. The extracted contaminated vapor is treated using carbon filters to remove VOCs prior to discharging the cleaned air to the atmosphere.

To address contaminated groundwater, this alternative involves pumping groundwater from the site for treatment and then reinjecting a portion of the treated water upgradient of the site to speed the flushing of contaminants from the aquifer. The contaminated groundwater will be treated by air-stripping before being reinjected on the site. The remaining portion will be treated further by carbon adsorption to achieve drinking water quality before being discharged on the downgradient side of the site.

In the air-stripper, groundwater is pumped to the top of an air stripping tower. Air is forced up through a tower as the extracted groundwater flows down. VOCs in the groundwater are transferred to the air stream which is next passed through an activated carbon filter to remove VOCs prior to discharge of the clean air to the atmosphere.

3. Vacuum Extraction/Low-Rate Groundwater Treatment. This alternative would utilize the same vacuum extraction technology used in alternative #2. Low rate groundwater treatment would utilize the same pumping and air-stripping tower/carbon adsorption system as alternative 2, but no groundwater would be reinjected to flush contaminants. Instead, all the extracted groundwater would be discharged downgradient on the site.

4. Low-Temperature Thermal Stripping/High-Rate Groundwater Treatment. In this alternative, contaminated soils would be excavated and treated in a mobile unit by heating the soil and forcing air through it to remove VOCs. The air would then be passed through a series of pollution control devices prior to release to the atmosphere. This alternative would require demolishing a portion of the existing building for excavation of contaminated soils underneath it. Treated soils would be stockpiled on-site before being replaced in the excavated area. This alternative would utilize the same groundwater treatment as the preferred alternative in #2 above.

5. Low-Temperature Thermal Stripping/Low-Rate Groundwater Treatment. This alternative would combine soil treatment in alternative #4 and the groundwater treatment used in alternative #3.

6. Off-Site Disposal/High-Rate Groundwater Treatment. This alternative would use the preferred alternative groundwater treatment technology in #2 above. Contaminated soils would be excavated and transported off site for treatment and disposal at a federally approved hazardous waste facility.

II. BACKGROUND ON COMMUNITY INVOLVEMENT AND CONCERNS

Community involvement at the Groveland Wells Superfund Site, of which the Valley Site is a component, has focused primarily on the contamination of the Groveland municipal wells, which were ordered closed by the State in 1979 due to contamination by VOCs. Historically, EPA has held and attended frequent public meetings to discuss the Agency's plans for site investigations, studies and cleanup plans. In particular, between 1985 and 1987, EPA held frequent meetings with residents and local officials to discuss the design and implementation of the remedial alternative selected for treatment of the contaminated Groveland Well Station No. 1. Community concern decreased once the well treatment began in 1987. Interest in the site again increased in 1987 when EPA conducted a pilot study of vacuum extraction at the Valley Site under the Superfund Innovative Technology Evaluation Program (SITE). Residents were generally supportive of the project, though there were concerns about potential delays in implementing the cleanup at the Valley Site due to the SITE demonstration. Since the SITE demonstration, community interest in the site has again leveled off and residents remain supportive of EPA's actions at the Valley Site.

Principal community concerns at the present time are summarized below.

Municipal Well Contamination

This concern focuses on the contamination and closing of Groveland's municipal wells. The shutdown, in 1979, resulted in water use restrictions, increasing resident interest in the site. Citizen concern seemed to peak during this period and during final design of a treatment system that would eventually allow one well to again be utilized. This well, Station No. 1 is now in full operation.

Scope of the Proposed Plan

Citizens expressed concern that the Proposed Plan addresses only the limited area of the Valley site and not the contaminant plume(s) leaving the site and impacting the Mill Pond area and the Johnson Creek and aquifer. Citizens are concerned that treating each area separately reduces the overall effectiveness of the cleanup.

Availability of Site Information

Citizens have recently expressed concern that information from the SITE Program demonstration has not been made available.

III. SUMMARY OF COMMENTS RECEIVED DURING THE PUBLIC COMMENT PERIOD AND EPA RESPONSES

This responsiveness summary addresses the comments received by EPA concerning the draft FS and Proposed Plan for the Valley site at the Groveland Wells Superfund site in Groveland, Massachusetts. Three sets of comments were received during the public comment period: two from the general public and one from the PRPs. Copies of the transcript of the July 26, 1988 informal public hearing are available at the Langley Adams Library, 185 Main Street, Groveland, Massachusetts 01834; the Groveland Town Clerk's Office, Groveland Town Hall, 183 Main Street, Groveland, Massachusetts 01834; and, at the EPA Records Center at 90 Canal Street, Boston, Massachusetts 02114.

Part I - Comments from the General Public and Other Interested Parties

The comments from citizens, along with EPA responses, are summarized and organized into the following categories:

A. Definition of the Site/Off Site Impacts

B. Vacuum Extraction/Groundwater Treatment

A. Definition of the Site/Off Site Impacts

Comment 1. One town representative stressed that the Valley site is but one section of the larger Groveland Wells Superfund site, and that EPA should look at the whole site because treating the Valley site separately creates a fragmented approach to the cleanup.

Comment 2. One town representative stated that EPA should give greater attention to the impacts of remedial activities at the Valley site on other areas of the Groveland Wells site, noting specifically that cleanup of the Valley soils should have an impact upon the Mill Pond area, a contaminant plume originating at the Valley site, and the Johnson Creek Aquifer.

Comment 3. A town representative stated that EPA should consider Groveland's aquifer protection plan and by-laws in determining cleanup plans for the Valley site.

EPA Response to Comments 1, 2, and 3:

EPA recognizes that the Valley Site is one primary component of a larger, more complex contamination problem at the Groveland Wells Site. In order to most efficiently address all areas of source and migratory contamination at the Groveland Site, EPA has developed a multi-source groundwater response plan which splits the Groveland Site into operable units for source-control and management of migration remedial actions. To date, this plan has entailed (1) the provision of an alternative water supply by restoring Station No.1 by treating for volatile organic contaminants, and (2) the selection of a source-control remedy for the Valley Site, which is the subject of this ROD.

This source-control remedy will reduce the volume of contaminants in soil and groundwater at the Valley Site, which includes the Valley property and immediately adjacent areas of soil contamination. This remedy will therefore reduce and minimize further migration of contamination in groundwater from the Valley Site.

The Valley site FS appropriately focuses on the source-control soil and groundwater remediation at the Valley Site. The ROD for the Valley Site discusses in detail the relationship between the source-control action and the other planned or executed actions at the Groveland Wells site, which includes consideration of the Town's aquifer protection by-law. The endangerment assessment performed for the Valley Site recognizes and evaluates environmental exposure in areas off of the Valley Site including the Mill Pond/Johnson Creek.

Subsequent to this source-control action at the Valley site, a management of migration (MOM) remedial action will be taken for the Mill Pond/Johnson Creek watershed and aquifer. A remedial investigation will be performed to characterize the nature and extent of surface water, sediment, and groundwater contamination in these areas, which includes the area between Valley and the Mill Pond. An endangerment assessment will be performed to characterize the human health and environmental exposures associated with this contamination. A feasibility study will be performed to develop and evaluate MOM remedial alternatives to address this contamination. Alternatives will be developed in consideration of the existing contamination, human health and environmental exposures, and the performance of Station No. 1 and the Mill Pond groundwater intercept/treatment system constructed and operated by Valley under agreement with the Massachusetts Department of Environmental Quality Engineering (DEQE).

This MOM remedial action will meet the CERCLA statutory requirements to utilize treatment as a principal element to permanently reduce the toxicity, mobility or volume of contaminants to the maximum extent practicable, and to attain the applicable or relevant and appropriate requirements (ARARs) of other Federal and State environmental statutes. Such ARARs would include, but not be limited to, requirements of the Safe Drinking Water Act and Clean Water Act. State ARARs would include the Ground Water Quality Standards established in 314 CMR §6.00. The Town's aquifer protection plan is consistent with these and other ARARs.

B. EPA's Preferred Alternative: Vacuum Extraction/High-Rate Groundwater Treatment

Comment 4. A number of citizens asked about the long-term effectiveness of vacuum extraction for soil treatment. One town representative noted that the report on the SITE demonstration had not yet been published and expressed interest in any information on long-term operation and maintenance costs of the system as well as total costs.

EPA Response: With respect to the long-term effectiveness of the soil remedy, vacuum extraction provides permanent reduction of the volume of volatile organic compounds (VOCs), to the maximum extent practicable by substantially removing them from the unsaturated soil.

Although the evaluation report from the SITE Program demonstration of the Terra-Vac vacuum extraction system (VES) has not been published, carbon usage rates suggest that significant VOC removal rates were realized. Based on usage (saturation) of 13,000 pounds of activated carbon with an estimated adsorption efficiency of 10%, approximately 1300 pounds of VOCs were removed during the demonstration.

The design of the VES to be implemented in accordance with this ROD will be based on the results of the SITE Program demonstration and a VES soil treatability study currently being performed at the Valley Site under a Consent Order.

The effectiveness of VES has also been evaluated for the purpose of this remedy selection based on its performance at several other sites at which it has been applied. Terra-Vac has published technical papers describing the results of these applications. Most notable is its application at a carbon tetrachloride spill site in Puerto Rico where contaminant reduction to 7 parts per billion in soil was achieved.

Comment 5. A town representative asked if the Town will be responsible for any of the operating costs for the vacuum extraction or groundwater treatment system.

EPA Response: EPA intends to negotiate with Valley for the design and implementation of the selected soil and groundwater treatment remedies. If Valley implements the remedy, which entails effectively operating and maintaining the treatment systems until the groundwater and soil cleanup goals established in the ROD are achieved, compliance and technical oversight will be provided by EPA. Valley would be required to monitor groundwater for some period after achieving the cleanup goals to ensure that the remedy is complete. If negotiations were not successful, then EPA would implement the selected remedy using CERCLA funds. In that case, EPA and the State would share the costs at a level of 90% Federal-funds and 10% State-funds and the State would assure operation and maintenance after the remedy is complete. In any event, the Town would bear no cost in the implementation of the remedial action.

Comment 6. One commenter asked what the source of the vacuum extraction cooling water would be.

EPA Response:
The final design of the vacuum extraction system to be implemented at

Valley may not include a heat exchanger. The conceptual design of a vacuum extraction system presented in the Valley Site FS did entail use of a heat exchanger for process gases. The cooling water was to come from the Valley facility supply, with flowrates dependent on the design. However, it is anticipated that the final design for the VES and groundwater treatment systems would be integrated to the maximum extent practicable. It is possible that vapor and liquid phase treatment from both systems could share components and that cooling water, if used, could come from the groundwater treatment system.

Comment 7. One town representative asked if there was adequate space on the site to construct all the required soils and groundwater treatment equipment.

EPA Response: EPA believes there is adequate space on the Valley site to construct both the VES and groundwater treatment system. The VES installed for the SITE Program and the system currently on site is contained entirely within the material storage area, where it could be located for final implementation. If additional space were required, it is conceivable that access to the adjacent wooded property could be secured for this purpose.

Comment #8. One commenter asked if the use of additional air strippers had been considered.

EPA Response: The Valley Site FS presented a conceptual design for the groundwater treatment system which entailed the use of one air stripper. The treatment system to be implemented in accordance with this ROD will be designed to be most effective and efficient at achieving the cleanup goals established in the ROD and may entail the use of multiple air strippers.

Comment 9. The Valley Site FS indicates that the VES is confined to the Valley property only. What will be done with the contaminated soil beyond the property line?

EPA Response: Although it is true that, based on soil gas analysis performed during the remedial investigation, soil contamination exists off of the Valley property, relatively little contamination has been detected in subsurface soil samples collected in this area. Nonetheless, the VES selected in this ROD requires monitoring of the unsaturated zone to the south and east to determine if these areas are contaminated. If determined tc be necessary, recovery could take place at these wells in the future. This may not be necessary as radii of influence from the existing extraction wells has been determined to be on the order of 50 to 75 feet and recovery of contamination from this area would likely occur with extraction within the property boundaries.

Comment 10. The Valley Site FS cost estimate does not include electrical costs or labor for routine maintenance.

EPA Response: The Draft Valley FS included the electrical costs for the vacuum extraction system in the cost tables (see Appendix B of the FS). This cost, which is an operation and maintenance cost has a present worth of approximately $60,000. The labor cost for routine maintenance is included in the operators cost for sampling. In fact, the vacuum extraction system requires very little operator involvement except for sample collection as all controls and the emergency shutdown is automatic.

Part II - Comments from the Potentially Responsible Parties

The PRPs stated that, in general, they support EPA's selected volatile organic source-control remedial alternative at the Valley site. This alternative involves soil vapor vacuum extraction and carbon adsorption treatment for soils and recovery/recirculation and air-stripping/carbon adsorption for groundwater treatment. The PRPs, however, raised the following comments or suggestions regarding the draft FS and Proposed Plan relative to the design of and expected costs for the selected alternative. The PRPs state that their intent is to demonstrate the availability of alternative remedial designs which employ the treatment technologies in EPA's selected remedy and which achieve an equal degree of protection of human health and the environment but at less cost than that presented in the Feasibility Study prepared by EPA contractor Roy F. Weston.

More specifically, the responsible parties submit information critical of, and relative to the:

- Volume (mass) of volatile organic compounds (VOCs) in the unsaturated soil zone;
- Design of the vacuum extraction system [radii of influence of the vents (extraction wells)];
- Volume of VOCs in the saturated zone; and
- Technical practicability of the proposed 30 gallon per minute (groundwater recovery rate) treatment system

With respect to other aspects of EPA's Proposed Plan as amended, the responsible parties take issue with the:

- Selected soil cleanup goals;
- Use of (vapor phase) carbon treatment of air stripper vapor emissions;
- Proposal to remove the subsurface disposal system leaching fields and underground storage tanks; and
- Proposal to address inorganic contamination present at the Valley Site.

These comments are addressed separately below. In general, with regard to the first four comments above, related to the design and cost for remedial alternative, EPA supports the basis for, and the development and detailed analysis of the source-control remedial alternatives in the feasibility study performed for the Valley Site. The FS achieved its intended purpose of developing and analyzing a range of source-control remedial alternatives which are protective of human health, attain ARARs, utilize permanent treatment and alternative technologies or resource recovery technologies to the maximum extent practicable and satisfies the statutory preference for treatment as a principal element.

EPA believes on this basis that the Administrative Record and FS provide the analysis necessary to select a cost-effective remedial action. The comments submitted on behalf of the PRPs do not affect this selection, but rather more appropriately address issues related to the design and implementation of the selected remedial action. In fact, these data further support EPA's selection as cost-effective as compared to the other alternatives.

Comment 1. EPA has over-estimated the volume of VOCs in the saturated and unsaturated zones. The PRPs state that the FS calculations presume that no VOCs have migrated from the immediate Valley area, and note that if that were the case there would be no off-site groundwater contamination.

EPA Response: The volume (and hence the mass) of VOCs used by Weston in the FS is based on admissions by Valley/GRC in response to an EPA information request and, to date, is the only factual basis for estimating the amount of waste disposed of historically. Historical waste disposal practices do suggest that this amount may be higher. While EPA recognizes that disposal of this volume or the actual undetermined volume occurred over the period of at least 17 years and that migration and attenuation has obviously occurred, it believes this estimate to be adequate for the evaluation of alternatives in the FS. While attempts can be made to estimate the present mass of contaminants on the site, they are gross estimates at best since they assume average concentrations over a substantial volume of soil and that the maximum concentration onsite has been detected. EPA believes that it is best to determine the actual mass of contaminants in soil based on the operation data collected during the treatability studies and implementation. In any event, the relative comparison of the alternatives is the same. EPA believes that the estimate provided by Valley/GRC's consultant is low based on the fact that 1300 pounds of VOCs were recovered during the SITE demonstration [13,000 pounds of carbon having been exhausted (with an estimated efficiency of 10%)]. Valley/GRC's calculations would only leave 450 pounds remaining onsite, which would require very little time to recover with vacuum extraction and which probably would have been recovered in their performance of the ongoing treatability study.

Comment 2. The SITE and treatability study results indicate that EPA's cleanup goals could be achieved using fewer vacuum extraction wells than are proposed by EPA.

EPA Response: The purpose of the feasibility study was to develop a conceptual design with enough detail to evaluate each alternative's cost, reliability, and engineering feasibility, and perform a comparative analysis with respect to the seven statutory criteria. The VES presented by Weston in the feasibility study is based on Weston's analysis of this technology. Weston did not have information from the SITE program demonstration. Further, this technology as presented is a design that Weston implements, and may not be similar to the design of Terra-Vac or any other vendor. EPA anticipates that the results of the SITE demonstration, and the treatability study being performed by Valley/GRC under the Consent Order Modification, will form the basis for the final design. In any event, the ROD defines this remedy in terms of performance standards and cleanup periods.

Comment 3. Removal of soils in the vicinity of the underground storage tanks is not necessary; cleanup of the soils is achievable using vacuum extraction. EPA also does not have authority to order removal of the soils as the regulations cited by EPA are either not yet in force or not applicable.

EPA Response: This ROD does not require removal of soils, subsurface disposal systems or the underground storage tanks. EPA anticipates that these items may be addressed, if necessary, under the environmental programs such as RCRA Part 265 or the Underground Storage Tanks program.

Comment 4. EPA has set target cleanup levels for soil based upon calculations intended to achieve certain contaminant concentrations in groundwater. EPA should define soil cleanup target levels in response to actual cleanup results in order to accurately determine impacts upon groundwater.

EPA Response: Indeed, this ROD establishes soil cleanup goals for the protection of groundwater, and to achieve the cleanup goals established for groundwater. Based on the relevance and appropriateness of the Maximum Contaminant Levels (MCLs) promulgated under the Safe Drinking Water Act, the groundwater cleanup goals are based on these contaminant specific MCLs. The area of attainment for these objectives is everywhere on the Property. Consequently, the soil cleanup goals have been established based upon soil/water equilibrium using the most conservative assumptions. This would reflect a worst case scenario at the site of static equilibrium and partitioning between the soil and water phase. The equation for this calculation is presented in the FS in Section 2. Statements relative to the soil cleanup goals being based on ARARs have been clarified to reflect that no chemical-specific ARARS exist and that the soil cleanup goals are based on achieving the groundwater ARARs under the worst case site conditions described above.

The area of attainment for the soil cleanup goals is everywhere on the Property corresponding to the groundwater area of attainment. These levels are to be achieved unless it is determined that they are not necessary to achieve the groundwater cleanup goals.

Comment 5. The rate of groundwater reinjection proposed by EPA for high-rate groundwater treatment will result in flooding of the unsaturated zone and interfere with the operations of the vacuum extraction system. Target cleanup goals can also be met using fewer extraction and injection wells.

EPA Response: EPA supports its contractor's determination of the rate of groundwater recovery/recirculation for the selected groundwater treatment remedy. Although a groundwater recharge test was performed at the Site by Valley/GRC, this only supports determination of a feasible injection rate in the absence of pumping, which is a part of the remedy.

EPA's objective in selecting a "high-rate" groundwater treatment system, which differs from the alternatives involving "low rate" by utilizing upgradient reinjection to accelerate contaminant removal from the saturated zone, is to achieve the groundwater cleanup goals as expeditiously as is technically feasible with a high-rate of aquifer restoration.

EPA believes that the actual design rate for recovery/recirculation can only be appropriately determined after performance of aquifer pumping as well as recharge tests, which will be performed as part of the remedial design work.

Comment 6. EPA lacks the authority to require use of carbon treatment on air emissions from the groundwater air strippers since no Federal air emissions limitations and no promulgated State air emissions limitation are applicable to the air stripper.

EPA Response: EPA does not have to justify all aspects of a selected remedial action on the basis of ARARs. In addition to attaining ARARs, remedial actions must, by statute, be protective of human health and the environment and meet other requirements.

EPA believes that vapor phase carbon adsorption on the air stripper is required to be protective of the environment and satisfy the CERCLA statutory preference for treatment that permanently reduces toxicity, mobility or volume of hazardous substances and constituents. It is unacceptable to remove contaminants from one media and transfer all or a portion of them to another media. This does not reduce mobility, but increases it. EPA further believes that such control may be necessary for protection of human health, as there are people residing within 100 feet of the site and that point of discharge. Further consideration is given to the fact that the Commonwealth is a "non attainment" area for ozone under the Clean Air Act. VOCs are precursors to ozone pollution

With respect to ARARs, the Massachusetts Air Quality Program, 310 CMR 7.00, requires submission of a Plans Application for all new or upgraded sources of VOC emissions. These plans must include description of proposed pollution control equipment. Although there are no regulations governing an allowable emission rate, Massachusetts has consistently applied a policy of requiring the use of the Best Available Control Technology (BACT) for all new or upgraded VOC emissions sources.

EPA has determined that such a requirement is in the ARAR category of To Be Considered material and therefore requires use of vapor phase carbon adsorption to be functionally equivalent with this policy.

The foregoing discussion also applies to the use of carbon adsorption for the vacuum extraction system.

Comment 7. EPA's initial calculations determined that the levels of inorganic contamination were below levels of concern. A later amendment to the Remedial Investigation essentially confirms this determination. Given that levels of arsenic and chromium are below background levels, and that maximum contaminant levels for copper, lead and cadmium are only proposed, there is no technical or legal basis to require cleanup of inorganics.

EPA Response: EPA believes it was necessary to perform an additional endangerment assessment for several reasons. First, since the time of the EA performed by Alliance in 1986 and 1987, EPA modified its approach to the remedial action cleanup goal attainment boundary at the "property boundary" to an area of attainment as "everywhere on the property." This is based on the classification of this aquifer under the EPA Groundwater Protection Strategy and a determination that the requirements of the Safe Drinking Water Act are relevant and appropriate to remedial actions at Valley. The Alliance EA also required modification based on new toxicological data for the indicator chemicals, and increased concentration of trichloroethylene from a previous high of 120 ppm to 150 ppm.

Of greatest importance was the necessity to include the inorganic metals: arsenic, cadmium, chromium, copper, lead and mercury. All of these were detected in groundwater samples from wells within the building material storage area above MCLs. Based on these concentrations and the intrinsic toxicological properties of these compounds, they were appropriately selected as contaminants of concern.

EPA believes these inorganic compounds are present in the material storage area well above the background levels in the area as exhibited by samples collected at the Valley Site in August 1988 from TW-22, upgradient of the building and in the Mill Pond area in October 1987 from DEQE 1-4, in which all these compounds were not detected.

The presence of inorganic contamination at the Valley Site is attributable to historic manufacturing operations and disposal of waste cutting oils containing these and other hazardous substances in the truck well subsurface disposal system, Brite-Dip disposal system, and to the ground surface in the material storage and parking lot area.

Comment 8. EPA addressed groundwater cleanup target levels for inorganics in an August 1988 letter and not in the July 1988 Proposed Plan. If EPA does propose a remedy or remedies for inorganics, an adequate opportunity to submit comments is expected.

EPA Response: This ROD does not select a remedy for inorganic contamination. Rather, EPA has determined that incidental inorganics treatment is necessary to comply with Massachusetts groundwater discharge standards. Groundwater treatment for inorganics may also be necessary for the efficient treatment of organic contamination.

IV. REMAINING CONCERNS

At the July 26, 1988 public informational meeting and at the informal public hearing held in Groveland on August 9, 1988, EPA representatives and local residents and officials discussed issues of community concerns as the site moves into the design and implementation of EPA's selected remedies for the Valley Source area at the Groveland Wells site. These issues and concerns are described briefly along with EPA comments on how the Agency intends to address these concerns.

(A) Citizens remain concerned about off site contamination resulting from the contamination at the Valley Area. Resident concern is focused on the possibility of additional well and groundwater contamination and the long term uses of town wells.

EPA Response: The Agency will address the contamination in the Mill Pond/ Johnson Creek watershed and aquifer, and the management of migration, in the next phase of the Groveland Wells Superfund site cleanup.

ATTACHMENT A

COMMUNITY RELATIONS ACTIVITIES
AT THE
VALLEY SOURCE AREA OF THE GROVELAND WELLS SUPERFUND SITE
IN GROVELAND, MASSACHUSETTS

Community relations activities conducted at the Valley Source area of the Groveland Wells Superfund site have included:

- July 28, 1987 - EPA issued a public notice announcing the upcoming public meeting on EPA's proposed demonstration of vacuum extraction at the site under the auspices of the Superfund Innovative Technology Evaluation (SITE) Program.
- July 1987 - EPA released a fact sheet on the vacuum extraction demonstration project.
- July 29, 1987 - EPA held a public meeting to allow interested parties to comment on EPA's proposed demonstration of vacuum extraction.
- June 1988 - EPA released a fact sheet announcing the completion of the vacuum extraction pilot study.
- July 1988 - EPA issued a public notice to announce the time and place of the Feasibility Study (FS) and Proposed Plan public informational meeting for the site and to invite public comment on the FS and Proposed Plan.
- July 1988 - EPA mailed the Proposed Plan announcing EPA's preferred alternative for addressing contamination at the site and the results of the Supplemental Remedial Investigation and the Endangerment Assessment to all those on the site mailing list.
- July 27, 1988 - EPA held a public informational meeting to discuss the results of the FS and the Proposed Plan.
- July 27 - August 16, 1988 - EPA held a public comment period on the Proposed Plan.
- August 9, 1988 - EPA held an informal public hearing to accept comments on the remedial alternatives evaluated in the FS and Proposed Plan.
- August 11, 1988 - EPA announced an extension of the public comment period through August 26, 1988.

ATTACHMENT B

UNITED STATES OF AMERICA
ENVIRONMENTAL PROTECTION AGENCY

Hearing in the Matter of:
GROVELAND SUPERFUND SITE

Tuesday
August 9, 1988

Groveland Town Hall
185 Main Street
Groveland, Massachusetts

The above-entitled matter came on for Public Meeting, pursuant to Notice at 7:15 p.m.

BEFORE:

LINDA MURPHY
Chief
Environmental Protection Agency
Massachusetts Waste Management Branch

JAMES CIRIELLO
Regional Project Manager
Environmental Protection Agency

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PROCEEDINGS

(7:15 p.m.)

MS. MURPHY: My name is Linda Murphy, I'm the Chief, Massachusetts Waste Management Branch at EPA, and I implement Superfund for Massachusetts sites. And with me tonight is Jim Ciriello, who's the Regional Project Manager for the Groveland Superfund site.

The purpose of tonight's hearing is to accept comments on four aspects of EPA's plan to clean up the Groveland site. Those aspects being the proposed plan itself, the remedial investigation of the contamination problem, the endangerment assessment of the contaminants, and the feasibility study of the cleanup alternatives.

The public comment period officially runs from July 27th to Aught 26th. We're accepting comments orally on the record tonight. We will accept comments in writing if they're postmarked to our Agency by August 26th. Tonight we would like to limit comments on the record to actual comments as opposed to questions.

The proposed plan was mailed to people on our mailing list on July 22nd, and if you're not already on our mailing list, just by signing up tonight, you'll be included. And if you know of any neighbors or other people that should be on the mailing list, you can add them to the list tonight.

On July 26th we had a public meeting which

Jim attended, I didn't attend it myself, but Jim attended that public meeting. It was an informal meeting, to explain the proposed plan to the public and to answer questions about the plan.

The reports that I mentioned before, which we're accepting comments tonight on, those being the remedial investigation, the feasibility study and the endangerment assessment, were released into the record on August 5th, and they're available at two locations. What's the location in Town, Jim?

MR. CIRIELLO: The repositories are the library and the Town Clerk's office.

MS. MURPHY: They're also available at our office at EPA in Boston on Canal Street.

The format for the hearing tonight is that we're going to have a formal transcription made of any comments that are entered into the record, and that transcript will be available at the formal repositories and at our office.

We'll open the hearing with a short summary of the proposed plan, even though this isn't a public meeting per se, for those of you who missed the public meeting, Jim's going to give a very quick summary of the proposed plan for your information, then we're going to accept public comments on the record. If anybody does make comments, we may ask them clarifying questions.

Following that, we'll close the hearing and the transcript will end, and we'll kind of have an informal public meeting again to answer any questions that you might have.

All comments submitted, whether they're oral submissions tonight or written submissions during the public comment period, will be categorized, they'll be summarized and responded to, and those responses will be mailed to the people on our mailing list. So if you make a written comment or an oral comment, you may not get an individual letter responding to your individual comment, but you will get a response that's included in the responsiveness summary.

So I think I will turn the meeting over to Jim Ciriello, who's going to describe EPA's, very quickly, EPA's proposed plan for cleanup of the Groveland site.

MR. CIRIELLO: Thank you, Linda. One point, I think, that Linda pointed out was that the comment period has b extended to August 26th, which is 21 days from the time that the reports were put in the record August 5th. That's an extension from what was the national proposed plan.

I just want to briefly review the proposed plan. The proposed plan is EPA's, is a plan which sets out EPA's preferred alternative for the cleanup of the Valley site on Washington Street.

This proposed plan and preferred alternative deals solely with the Valley Manufactured Products Company facility, which is on Washington Street, located above Mill Pond. It's an action known as a source-control action.

Over the last couple of years, EPA has performed some various studies, feasibility studies of the Valley property, along with the Valley Company, and most recently, Valley completed a remedial investigation of contamination of the property and EPA completed an endangerment assessment and a feasibility study, based on the remedial investigation work that Valley had conducted.

The remedial investigation located at the Valley site, showing it in relation to Center Street, Washington Street, Valley sits in a residential area, those square blocks are houses, and St. Patrick's Church is down on Center Street.

The remedial investigation was conducted to define the nature and extent of contamination, the source of contamination on the property, and to identify soil and groundwater contamination. The endangerment assessment is an evaluation based on the results of the remedial investigation combined with the risk that the site poses to the environment and to public health.

Basically, we have found through the remedial investigations that there is groundwater contamination, soil contamination on the site, primarily in one area, on the southern side of the building known as the material storage area. The contamination principally consists of volatile organic compounds in soil and in groundwater.

Based on the endangerment assessment and the assessment of the risk that the site posed, we've established four broad cleanup objectives. Those are to prevent ingestion of contaminated groundwater on the property or downgradient of the property and prevent direct contact, ingestion of contaminated soil on the property, prevent inhalation of volatile organic compounds that might occur upon excavation of the property, and prevent migration of groundwater contamination into groundwater from the property, contaminating downgradient water supplies.

Based on those general objectives, we've established actions, or identified actions which need to take place on the property as part of remedial action to prevent exposure by those four routes shown on the previous slide, and those three actions, generally, are to treat and remove the source of soil contamination, treat and remove any source of soil contamination, it would be something like the septic system or a spot of soil that had a high concentration of contaminants, treat or remove the soil, and to treat the groundwater to achieve standards which we've adopted as our target levels.

The Feasibility Study is the document prepared by EPA which evaluates various cleanup technologies, treatment technologies for groundwater and soil, and the Feasibility

Study performs a detailed evaluation of various alternatives which address both soil and groundwater contamination.

In the Feasibility Study as outlined in the proposed plan, we evaluated in detail six alternatives for achieving our objectives of cleaning up the Valley site, and the six alternatives are shown here on this slide.

As part of the Feasibility Study, EPA has established target cleanup levels, which appear in the FS Report. These target cleanup levels are largely based on existing standards, existing drinking water standards in groundwater, and that is maximum contaminant levels or proposed maximum contaminant levels, those come out of, they're established in the Safe Drinking Water Act, and EPA has established those as our target cleanup levels for groundwater.

The target cleanup level for soil is based on achieving those target cleanup levels in groundwater. That is, the remedial action level for soil is the soil concentration that would not exceed the concentration in groundwater.

In order to achieve those target levels, we've developed six, or five alternatives, principally. The first alternative is no action, which is a base-line alternative. The other five alternatives will achieve those target levels, but at different, within different time frames.

And there are two principal treatment systems proposed. The first treatment system is an in situ treatment system, it treats the soil in place, it's known as vacuum extraction. Vacuum extraction is something we've discussed in the past, in that we did a demonstration under the Superfund Innovative Technology Evaluation Program of the vacuum extraction system last winter.

We have two alternatives involving vacuum extraction which will treat the soil in the same order of time, that is 10 years, to the target levels, and with each of those vacuum extraction systems we have two different rates of groundwater treatment.

The high-rate groundwater treatment system is a treatment system which would, it's projected, would treat the groundwater on the site within 10 years, the low-rate groundwater treatment system would require substantially longer than 30 years. The low-rate treatment system is a passive system, which simply collects the groundwater migrating from the site, treats it, and discharges it downgradient. The high-rate system involves some recirculation of groundwater to accelerate the flushing process.

The other treatment system that was considered is an above-ground treatment system for soil, known as low-temperature thermal stripping. That involves excavation of the soils that are contaminated on the property, processing the excavated soils through a low temperature, on the order of a couple of hundred degrees Fahrenheit, treatment system to volatilize, to drive off the volatile contaminants with heat, and then soils, after being treated, would be replaced in the excavation.

We have two alternatives involving above-ground, low-temperature thermal stripping. Each of those involve the same, the hight-rate and the low-rate groundwater treatment system, it's the same configuration as it is with the vacuum extraction system.

And the last alternative, or the fifth treatment alternative is an alternative involving excavation of on-site soils and off-site treatment and disposal of those soils, backfilling the property with clean borrow.

Those are the six alternatives we've conducted a detailed analysis on.

The preferred alternative, EPA's preferred alternative as presented in the proposed plan, is the second alternative, involving vacuum extraction in place and high-rate groundwater treatment system. With this alternative, we expect, or project remediation to take place within 10 years.

In evaluating these six -- in evaluating the seven alternatives, EPA considers a number of factors to do a comparative analysis of the six alternatives, and the factors that are involved are overall protection of human health and environment, compliance with other environmental laws, the long-term effectiveness of the alternatives and the permanence of the alternatives. The amendments to the Superfund Statute require, essentially, or contain cleanup goals and require that we attain all of the standards, requirements, criteria of all of their environmental laws. Hence, we've established target levels as being at what's equivalent to drinking water standard for groundwater. And the other thing that the Superfund amendments require is that we have a preference for permanent remedies, permanently reducing the toxicity, mobility and volume of the contamination, to get us away from relying on land-disposal options and so forth. So we evaluated alternatives which will permanently reduce or eliminate the contamination on the property, both in soil and groundwater.

Another factor that's used in the comparative analysis is the short-term effectiveness, which is the effectiveness of, during construction, during the actual remedial action, are there any adverse impacts on human health environment from actually implementing it. With something like excavation, there might be some short-term effects that would be considered in comparing it to something in situ which doesn't involve excavation.

Implementability is also another factor used to evaluate these. Is it administrati~~vely implementable~~ and is it also technically implementable? Is the equipment available, can you meet the necessary equivalence of permits that were required? And a final factor would be the cost, capital and O&M cost, operation and maintenance costs.

These factors are in the proposed plan, known as the Nine Criteria. I just described seven of them. The last two criteria are state acceptance and community acceptance. We evaluate, in our decision for selecting an action and an altrnative, we evaluate community acceptance and state acceptanc Your comments tonight and your comments in writing go into this factor known as community acceptance in our selecting a remedy for the property.

Just briefly, the preferred alternative that EPA's presented, again, involves vacuum extraction for soil, this is a very simple schematic of a soil vapor vacuum extraction system, which involves the installation of extracti wells above the water table in the unsaturated soil zone, monitoring wells, again above the water table. There's a vacuum pump which is shown as No. 5 here. The vacuum pump creates a vacuum, essentially, on the extraction wells, drawing soil vapor out of the wells and from the ground into the wells. That vapor is drawn through carbon, in this case, for absorption of the contaminants out of the vapor, and then the clear vapor or treated air is discharged to the atmosphere. This is similar to the configuration that was in place at Valley during our demonstration this winter.

The groundwater system simply involves groundwate recovery wells in the water table, the groundwater is pumped from the ground, and in this configuration and in our alternatives, groundwater is passed through an air-stripping chamber where the volatiles are stripped from the water, air is discharged after going through activated carbon. The groundwater is then, depending on whether it gets recharged above -- whether it gets recharged into the ground for further collection or if it gets discharged out of the site area, if it gets discharged out of the site area, the water would go through activated carbon for further treatment and then discharged. It would be discharged at a drinking water standard essentially. Water that's passed through the site again, doesn't have to achieve those levels, and would then go through the air stripper alone and then back through the system to be recovered once again.

That's it for the slides.

That's a very quick version of the two treatment systems, or the preferred alternative which involves treatment for soil or treatment for groundwater.

MS. MURPHY: Okay, thank you, Jim.

Again, we're going to accept public comments for the record at this point in time, and following the public comments, we're going to close the transcript officially and we'll have an informal meeting, so if you have questions about Jim's presentation and you don't want to make a formal comment, we're available to answer those questions.

We didn't have anybody who signed the index card, is there anybody who would like to make a public comment for the record at this time?

(No response.)

MS. MURPHY: I think we'll close the record for the moment.

(Whereupon, at 7:32 p.m., the hearing was concluded.)

CERTIFICATE OF REPORTER AND TRANSCRIBER

This is to certify that the attached proceedings before: LINDA MURPHY

in the Matter of:

GROVELAND SUPERFUND SITE

Place: Groveland, Massachusetts

Date: August 9, 1988

were held as herein appears, and that this is the true, accurate and complete transcript prepared from the notes and/or recordings taken of the above titled proceeding.

V. Rasmussen
Reporter

8/12/88
Date

J. Rasmussen
Transcriber

8/12/88
Date

ATTACHMENT C

NUTTER, McCLENNEN & FISH

ONE INTERNATIONAL PLACE
BOSTON, MASSACHUSETTS 02110-2699

617 439-2000

TELEX 94-0790 TELECOPIER 617 973-9748

September 7, 1988
2843-92

FOR INCLUSION IN THE EPA VALLEY SITE ADMINISTRATIVE RECORD

VIA HAND DELIVERY

Mr. William Walsh-Rogalski
Assistant Regional Counsel
U.S. Environmental Protection Agency
JFK Federal Building - RRC-2003
Boston, Massachusetts 02203-2211

Re: Comments of Valley Manufactured Products Company, Inc. and Groveland Resources Corporation on EPA Valley Site Proposed Plan

Dear Bill:

Please find enclosed the complete and final comments of Valley Manufactured Products Company, Inc. and Groveland Resources Corporation on EPA's Valley Site Proposed Plan. The comments now contain a section discussing inorganics, as well as a new Appendix G. Formal changes were made to the cover page and table of contents.

As stated in my letter to you September 1, I stand ready, as do my clients' consultants, to meet with representatives of EPA to discuss the contents of the comments and any other issues pertaining to remedial action at the Valley Site. It is my hope, and that of my clients, that careful and serious consideration by EPA of these comments (together with the balance of the Valley Site Administrative Record) will yield a selected remedy of a scope responsive to the conditions actually observed at the Valley Site, as described in the Lally RI and SRI reports.

HYANNIS · AMSTERDAM: HOUTHOFF NUTTER McCLENNEN
COUNSEL: LONDON · TOKYO

If you have any questions or comments, please feel free, as always to contact me.

Very truly yours,

Martin C. Pentz

MCP:ccd
2166c

Enclosure

cc: √James S. Ciriello, Remedial Project Manager
(with enclosure)

COMMENTS ON THE
VALLEY SITE PROPOSED PLAN

Submitted by

Valley Manufactured Products
Company, Inc.

Groveland Resources Corporation

September 7, 1988

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I. INTRODUCTION

EPA has released a "Proposed Plan" announcing its selection of a preferred alternative to address the presence of volatile organic compounds ("VOCs") in soil and groundwater at the Valley Manufactured Products Company, Inc. ("Valley") facility located at 64 Washington Street, Groveland, Massachusetts (the "Valley Site"). The Valley Site lies within the boundaries of the Groveland Wells Superfund Site, which was defined and listed by EPA as a "National Priorities List" site in 1982, under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 ("CERCLA"). Pub. L. No. 96-510, 94 Stat. 2767 (1980).[1] _See_ National Contingency Plan ("NCP"), Appendix B, 40 CFR Part 300, App. B. EPA apparently has determined to treat the Valley Site as a discrete "operable unit" within the meaning of §300.68(c) of the NCP, 300 CFR §300.68(c), and has announced in its Proposed Plan an intention to address other portions of the Groveland Wells Superfund Site "in a separate investigation and cleanup action."

The Valley Site Proposed Plan was furnished to counsel for Valley and Groveland Resources Corporation ("GRC," the owner of the Valley Site) and, by letter dated August 17, 1988, EPA advised counsel for Valley and GRC of certain additional determinations intended to form a part of the Proposed Plan, as well as certain corrections to and clarifications of matters discussed in the Proposed Plan as originally released. The comments set forth herein were prepared after careful review by counsel and Valley and GRC's technical consultants of the Proposed Plan (as amended) and all underlying documents, including the remedial investigation ("RI") and Phase I supplemental remedial investigation ("SRI") reports prepared by Valley and GRC's consultant, M. Anthony Lally Associates ("Lally"), the Valley Site endangerment assessment (Alliance, 1987) and draft amendment thereto (Camp, Dresser & McKee, 1988) and the draft feasibility study prepared by Roy F. Weston, Inc. for EPA (the "Weston FS").

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[1] Since the listing of the Groveland Wells Superfund Site on the National Priorities List, CERCLA has been amended or affected by a number of enactments, most recently and most significantly by the Superfund Amendments and Reauthorization Act of 1986 ("SARA"), Public Law 99-499, 100 Stat. 1613. All references in these comments to CERCLA are to Public Law 96-510 as amended through SARA.

The comments in this document are quite detailed and are intended to be constructive. Valley and GRC are principally concerned that certain fundamental flaws in the Weston FS have yielded grave miscalculations of the necessary design of and expected costs for EPA's preferred technical approaches to both soil and groundwater remediation. The purpose of these comments is to point out the significant errors and deficiencies in the Weston FS and to demonstrate the availability of alternative remedial designs which employ the technology preferred by EPA and achieve a degree of protection of human health and the environment equal to that of the preferred alternative, but at vastly reduced cost.

II. CLEANUP OF VOLATILE ORGANIC COMPOUNDS

The Valley Site Proposed Plan, as originally issued by EPA, sets forth EPA's proposal of a cleanup plan consisting of two principal components: soil vapor vacuum extraction to remove VOCs from the soil strata in the unsaturated zone, and groundwater extraction, treatment and reinjection to remove VOCs from the groundwater at the Valley Site. According to the Proposed Plan, this two-pronged approach "is designed to address VOC contamination in site soil and groundwater, since VOCs are the major contamination problem detected at the site." Proposed Plan at 7. While reference is made in the Proposed Plan document to the detection of inorganic chemicals at the Valley Site, and to the potential for pretreatment of extracted groundwater to remove inorganic chemicals, the focus of the Proposed Plan document clearly is upon VOC remediation.2/ Accordingly, these comments are structured first to discuss cleanup of VOCs by vacuum extraction and groundwater treatment, with discussion of the evidence regarding the presence of inorganic chemicals at the Valley Site reserved to a separate section, below.

In describing EPA's preferred alternative, the Proposed Plan states that EPA preliminarily has recommended that "Alternative 2, Vacuum Extraction/High-Rate Groundwater Treatment" as described in

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2/ Indeed, the Weston FS, from which the preferred alternative was selected, did not purport to address any cleanup of inorganic chemicals, but "only technologies to remedy existing VOC contamination at the Valley Site." Weston FS at 1-2.

the Weston FS "be used to address contamination at the Valley Site." Proposed Plan at 7. Further, EPA relies upon the detailed cost estimates contained in the Weston FS in announcing the expected costs of the selected remedy. *Compare* Proposed Plan at 7-8 *with* Weston FS, Appendix B. Accordingly, any meaningful comments with respect to the design and expected costs of the remedy recommended in the Proposed Plan must be directed to the design description and cost estimates contained in the Weston FS.

The discussion in the following subsections of these comments will demonstrate that the Weston FS is fatally flawed in that it fails, in designing and estimating the cost of remedial alternatives, to make adequate use of the extensive data base developed in the course of the Lally RI and SRI. In particular, it will be shown that the failure of the Weston FS even to attempt an estimate of the volume of VOCs *presently* in the soil and groundwater at the Valley Site (based on ample data presented in the Lally RI and SRI reports) has resulted in the preparation of unduly elaborate and costly designs for the soil and groundwater treatment systems as well as grossly exaggerated cost estimates for operation and maintenance of those systems. Finally, a number of other errors, omissions and unfounded assumptions of the Weston FS also will be highlighted for their cumulative contribution of the excessive design and expected cost elements of the preferred alternative.

A. Soil Cleanup - Vacuum Extraction

As previously stated in correspondence to EPA, Valley and GRC support the use of in-situ soil vapor vacuum extraction technology to remove VOCs from unsaturated zone soils at the Valley Site.[3] The discussion in this section therefore is not directed to the appropriateness of the recommended technology. Rather, Valley and GRC, will endeavor herein to lay the groundwork upon which the party(ies) undertaking the remedy (whether EPA or Valley and GRC) can base (1) a cost-effective design of a vacuum extraction system for the Valley Site, and (2) a reasonable estimate of the expected costs of this component of the remedy.

1. Volume of VOCs in the Unsaturated Zone

In determining the appropriate design and expected operating costs of a vacuum extraction system, one critical consideration is

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3/ Valley and GRC view vacuum extraction as conceptually similar to in-situ soil flushing, with the exception of the difference in the medium employed to strip VOCs from soil particles (air versus water). Indeed, had EPA indicated a preference for in-situ soil flushing, in accordance with the recommendation contained in Lally's 1985 feasibility study report (the "Lally FS") Valley and GRC would have supported EPA's choice.

Nothing in these comments, therefore, should be construed as a concession by Valley or GRC of the appropriateness of EPA's refusal to rely upon the Lally FS in selecting a remedy for the Valley Site. Furthermore, nothing in these comments should be construed as an expression of agreement with the conclusions stated at pages 3-17 to 3-18 of the Weston FS with respect to the long-term protectiveness and technical implementability of in-situ soil flushing at the Valley Site.

the volume of VOCs which the system will be required to remove. The Weston FS expressly states that "[t]he annual O&M costs for the vacuum extraction system would be largely for carbon replacement, based upon recovering 3,000 gallons of solvent." Weston FS at 4-14.[4/] In basing an expected cost analysis on the premise that "3,000 gallons of solvent" (presumably VOCs) are to be removed, the Weston FS commits a fundamental and grave error, and proceeds in a fashion inconsistent with the NCP and EPA's 1988 Draft Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (the "1988 Guidance"). The result is an enormously inflated and misleading cost estimate for vacuum extraction.

It is by now axiomatic that the two major components of the RI/FS process, the remedial investigation and the feasibility study, are interactive, that is, "data collected in the RI influence the development of remedial alternatives in the FS, which in turn affects the data needs and scope of treatability studies and additional field investigations." 1988 Guidance §1.3 at 1-7. See also 1988 Guidance §4.1.1 at 4-2. See generally 40 CFR §§300.68(d)-(h). Data generated through additional site characterization and treatability studies are then used to further define remedial alternatives, 1988 Guidance §7.2.1 at 7-5 to 7-6, and "to refine cost estimates for remedial action alternatives." 1988 Guidance §7.2.3.5 at 7-24.

One significant category of data generated through an RI which is to be used in defining and estimating the cost of remedial

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[4/] Insofar as the Weston FS considers volume for design purposes, presumably the same assumed volume is used.

alternatives is "the extent or volume of contaminated material." 1988 Guidance §5.2.1.2 at 5-6. See also 1988 Guidance §7.2.1 at 7-4 to 7-5. Further, the 1988 Guidance, in illustrating typical data requirements for remediation technologies, specifically lists "[c]oncentration of volatile compounds" as an example of data required to evaluate in-situ vapor extraction of soils. 1988 Guidance, Table 6-1 at 6-5.

Clearly, then, one function of the Lally SRI properly should have been to collect data defining the extent or volume of VOCs in the unsaturated zone. This in fact was one stated purpose of the SRI, see Administrative Order by Consent, U.S. EPA Docket No. 1-87-1091 (Region I) (the "SRI Order") §6 at 4, and the Lally Phase I SRI report (together with the original Lally RI report) in fact presents the necessary data upon which an estimate of the volume of VOCs in soil can be made. Furthermore, the SRI Order contemplated the performance of a soil treatability study, SRI Order, Appendix A (workplan) at 14, and a soil vapor vacuum extraction treatability study presently is underway at the Valley Site, in accordance with Modification No. 1 to the SRI Order.5/ The data generated through this study will permit any necessary refinement of VOC volume estimates made based on presently available data.

5/ The SRI Order originally contemplated a soil flushing treatability (or "leachability") study.

Against this background, the capriciousness of the approach of the Weston FS to estimating VOC volumes in the unsaturated zone becomes manifest. While the Weston FS avoids reference to the basis for its assumption that "3,000 gallons of solvent" will be recovered by the vacuum extraction system, Weston FS at 4-14, one can only conclude that it is based upon the statement made earlier in the report that "[a] total of 3,000 gallons is estimated to have been discharged to the environment . . .," Weston FS at 1-10 to 1-11. That estimate, in turn, apparently is ultimately based upon anecdotal accounts of past disposal practices given by persons employed at the Valley Site at various times, accounts which reach back as many as 25 years. See Weston FS at 1-10 (referring to "information" in the SRI Order).

Whatever the value of these historical accounts to an estimate of the total volume of VOCs discharged at the Valley Site since the screw machine operation was started, such a calculation sheds precious little light upon the issue of concern in the context of designing and estimating the cost of a vacuum extraction system, viz.: what is the volume of VOCs presently existing in unsaturated zone soils at the Valley Site? The answer to this question is entirely absent from the Weston FS.

Furthermore, the substitution of the 3,000 gallon estimate for a calculation of volume based on available data is simply insupportable as a technical matter. To make such a leap, one must assume that each and every gallon of VOCs discharged at the Valley Site, perhaps as many as 25 years ago, presently resides in unsaturated zone soils within the Valley Site property boundaries. Such an assumption flies in the face of the well-understood fate and transport behavior of VOCs (particularly TCE) after release into the environment.

For example, the approach of the Weston FS fails to account for the expected loss of TCE to the atmosphere through volatilization, from the ground surface after a spill or through soil strata after liquid phase TCE penetrates the ground surface. Similarly, in relying upon the 3,000 gallon estimate, the Weston FS fails to account for migration of VOCs into the saturated zone, a phenomenon clearly recognized elsewhere in the Weston FS. In light of the operation of these fate and transport mechanisms, a reasonably reliable estimate of the presently existing volume of VOCs in the Valley Site unsaturated zone can be obtained only by means of calculations employing the soil and soil gas analytical data presented in the Lally RI and SRI reports.

An estimation of the volume of VOCs in the Valley Site unsaturated zone based upon presently available data is presented in Appendix A to these comments. In the southeast region of the building, where detected VOC concentrations have been highest, soil analytical data from samples taken during boring activities are used.[6] For the area beneath the Valley building where soil gas has been detected, but analytical data from soil borings are unavailable, soil gas data are used, together with a data-based and experimentally verified ratio of soil gas VOC concentration to soil VOC concentration, permitting estimates of VOC volume in this area as well.[7]

The result of the calculations contained in Appendix A is an estimate that approximately 140 gallons of VOCs presently exist in liquid or vapor phase in unsaturated zone soils at the Valley

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6/ In order more fully to characterize the extent of VOC-containing soils, the calculation of VOC volume in the unsaturated zone in the southeast region of the building relies in part upon certain draft data obtained by Valley during the course of EPA's Superfund Innovative Technology Evaluation ("SITE") project at Valley, in the course of which some eight borings were driven in the area adjacent to the south wall of the Valley building. Valley and GRC are informed that validated data from these borings will be available as of September 20, 1988. (See letter dated August 23, 1988 from Mary K. Stinson, Project Manager, to counsel for Valley and GRC, attached as Appendix B.) In the event that quality assurance/quality control procedures have resulted in rejection of any draft data relied upon in Appendix A, appropriate refinements to the calculations may be made when the final draft technical report from the SITE project is released. Valley and GRC request that the SITE project technical report be included in the Valley Site administrative record.

7/ The degree of accuracy of this calculation is, of course, limited by the inherent limitations of soil gas analysis. Valley and GRC request only that EPA consider this calculation as an indicator of the order of magnitude of VOC volume in the area for which this calculation is employed.

Site.[8] As noted, still further soil VOC concentration data presently is being prepared from samples collected during boring activities conducted under Modification No. 1 to the SRI Order. When available, these data may be used to further refine the volume estimate.

Calculation of the presently existing volume of VOCs in the Valley Site unsaturated zone thus reveals that the 3,000 gallon figure employed in the Weston FS for estimation of carbon costs for the vacuum extraction system is wide of the mark by more than an order of magnitude. If the data-based calculation of VOC volume is used to estimate carbon costs, as the NCP and the 1988 Guidance require, then the present worth of such costs (assuming a 10-year operation period) should be estimated to fall below $100,000, even if the 140 gallon figure is doubled.

The expected cost analysis on the basis of which a preferred alternative is chosen can have a significant impact upon EPA decision-making at a number of points in the RI/FS process and beyond. For example, in exercising its discretion to enter into an agreement with a private party to perform response actions, the ability of the private party to meet the financial obligations associated with conduct of the remedy frequently is determined by reference to the expected costs thereof, as estimated in the FS. Cf. 42 U.S.C. §122(f)(4) (in assessing the appropriateness of settlement, EPA is to consider "[w]hether the remedial action will be carried out . . . by the responsible parties themselves.") Valley and GRC submit that EPA reliance upon the expected costs for vacuum extraction set out in the Weston FS would constitute a grave error, in part because that analysis grossly overestimates carbon replacement costs based upon a legally and technically insupportable overestimate of the volume of VOCs to be recovered by the system.[9]

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[8] It should be noted that the calculations in Appendix A do not purport to account for any reduction in the volume of VOCs in unsaturated zone soils at the Valley Site resulting from the operation of the SITE program pilot vacuum extraction system. All data used were derived from samples taken prior to operation of that system.

2. Design of Vacuum Extraction System: Radii of Influence of Vents

The Weston FS states, with respect to the preferred alternative, that "[a]pproximately 30 extraction wells would be located throughout the area of significant soil contamination at the southern end of the building." Weston FS at 4-9 . It is stated that "[i]t was assumed that a vacuum could be induced within the soil in a 15-25 foot radius surrounding each vent, and a 25-foot by 25-foot grid system was used to estimate that 30 vents would be required." Weston FS at 4-9 to 4-10. As demonstrated below, a design of a vacuum extraction system for the Valley Site based on the assumptions stated in the Weston FS would contravene the NCP and the 1988 Guidance, and would result in substantial undue expense and interference with the operation of the Valley plant.

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[9] The suggestion has been made that an undetected "pool" of free TCE may exist in the Valley Site unsaturated zone. The likelihood of the existence of such a "pool" is discussed in Appendix C. It is concluded that the probability that such a "pool" exists, and is of substantial size, is extremely low.

As discussed in the preceding section, the interactive RI/FS process calls for input from RI to FS in the form of site characterization and treatability studies. The preceding section dealt with the failure of the Weston FS to make use of site characterization data from the Valley Site RI and SRI in estimating unsaturated zone VOC volume. This section deals with the failure of the Weston FS to make use of treatability study data from the SITE project and the treatability work presently underway at the Valley Site.

As stated in the 1988 Guidance, "[t]he primary objectives of treatability studies are: [(1) to] [p]rovide sufficient data to allow treatment alternatives to be fully developed and evaluated during the detailed analysis and support remedial design of a selected alternative [and (2) to] [r]educe cost and performance uncertainties for treatment alternatives to acceptable levels so that a remedy can be selected." 1988 Guidance §6.1.1 at 6-1. Detailed evaluation such as that undertaken in Section 4 of the Weston FS is premature and inappropriate where existing data, absent a treatability study, is insufficient to achieve the two quoted objectives. 1988 Guidance, Figure 6-1.

At the Valley Site, a wealth of treatability data have been and will be developed. The SITE program project has been completed and, as noted, the data generated thereby is expected to be available by September 20, 1988. In addition, a soil vapor vacuum extraction treatability study presently is underway at the Valley Site. The combined data output of these two studies should form a more than ample basis for the design of the vacuum extraction system.

By contrast, a review of the Weston FS gives no clue with respect to the basis for the design assumed therein. Whatever the basis for the radius of influence figure quoted in the Weston FS (15-25'), it is extremely unlikely that the radius of influence of any of the extraction wells will in fact be less than 35 feet at the Valley Site and indeed there is reason to believe that many will exceed that figure.

Appendix D to these comments contains a discussion, prepared by Terra Vac, Inc., summarizing its experience at other sites where vacuum extraction has been applied and venturing a preliminary estimate of the radii of influence expected to be encountered at the Valley Site. Given the relatively high permeability of the soil strata at the Valley Site (excepting only the clay layer) and given the fact that much of the area to be evacuated is "sealed" beneath the concrete building slab, the Valley Site presents quite favorable conditions for a relatively wide radius of influence of the extraction wells.

Valley and GRC believe that the results of the SITE study and treatability study will demonstrate a need for few, if any, extraction wells beyond those already installed to conduct the remedy. These studies may yield data indicating other areas in which the design discussed in the Weston FS may be scaled-back, without sacrificing protectiveness, to yield a far more reasonable capital cost. EPA is obliged to consider these data and to approve a cost-effective design for the vacuum extraction system. See NCP §300.68(i)(2) (40 C.F.R. §300.68(i)(2)) (in selecting the appropriate "extent of remedy" the lead agency is to consider, among other things, "cost").

3. Leaching Fields, Underground Storage Tanks

The Weston FS asserts that "the proposed corrective action regulations [RCRA §3008(u)] would apply to and require removal of the underground storage tanks and waste disposal systems, including all contaminated soils associated with the tanks and subsurface disposal systems." Weston FS at 2-6. (Bracketed material in original.) This statement is incorrect as a matter of law.

First, there is no RCRA section 3008(u). Section 3008(h) authorizes the issuance of corrective action orders with respect to interim status facilities, and section 3004(u) establishes corrective action requirements for permitted facilities. Second, the RCRA Subtitle C standards have no application to Valley's underground storage tanks (USTs). Valley's USTs have at all times been used for storage of virgin products, not wastes, and therefore are not subject to EPA jurisdiction under RCRA. Third, to the extent that the quoted language purports to refer to EPA's proposed UST regulations under sections 9001-9009 of RCRA (see 52 Fed. Reg. 12662 (April 17, 1987)), the language grossly misstates the pertinent provisions. Those proposed regulations require closure *or repair* of a UST, and only if it is found to be leaking. (See proposed 40 C.F.R. §§ 280.61, 280.71(a)(2)). There is no requirement that contaminated soils be removed; rather, the proposed regulations merely require that a plan for "cleanup" be approved. (See proposed 40 C.F.R. § 280.73.) Also, Valley and GRC question whether proposed regulations are properly considered as relevant and appropriate under §121(d) of CERCLA (42 U.S.C. §9621(d)) when they have neither been finalized nor adopted or followed as policy by EPA.

The Massachusetts Board of Fire Prevention Regulations, 527 CMR 9.00, also do not require the removal of any of Valley's underground storage tanks; nor do they require the removal of any contaminated soils. One of Valley's USTs is no longer in service. Since it is located beneath a building it will be abandoned in place in accordance with 527 CMR 9.21(1). Valley's other USTs, which are still in use, will be tested and managed in accordance with 527 CMR 9.16-9.18.

The language from the Weston FS quoted above refers to "subsurface disposal systems," and thereby appears to state that all soils associated with the former Brite-Dip and MDC oil/gas separator leaching fields must be removed and disposed of. However, we find nothing in EPA's RCRA regulations to support such a conclusion. Neither the corrective action requirements at 40 C.F.R. §§ 264.100-264.101, nor the closure requirements at 40 C.F.R. § 264.280 contain any such standard. Cleanup of any VOCs in soils associated with the leaching fields by means of vacuum extraction is entirely consistent with EPA's RCRA regulations.[10]

Since there is no basis, in law or otherwise, for the conclusion of the Weston FS that the Valley USTs must be removed, this item must not form a part of the preferred alternative or of any expected cost analysis. Likewise, since there is at present no basis for concluding that VOCs cannot be removed from leaching field areas by means of vacuum extraction, it is premature to assume that excavation and off-site disposal of those materials will be necessary to achieve cleanup goals or to comply with RCRA regulations.

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[10] While the FS is silent on the issue, it has been suggested that excavation and off-site disposal of leaching field soils may be necessary on the ground that the vacuum extraction system would not adequately treat these areas. No basis for such a conclusion can be found in the documents underlying EPA's Proposed Plan. As a practical matter, such questions are best addressed in the context of monitoring the process of VOC removal in the course of operation of the remedy.

B. Soil Cleanup - Selected Target Levels

The Weston FS, as clarified and corrected by EPA's August 17 correspondence, recommends soil cleanup "objectives" by means of a calculation which purportedly yields the soil concentration levels for VOC "contaminants of concern" necessary to maintain the target concentrations selected for the same chemicals in groundwater. Since the figures generated by this calculation, while useful, do not in fact reflect the real-world dynamic equilibrium between soils and groundwater at the Valley Site, Valley and GRC submit that they must not be employed as hard and fast standards by which the success or failure of the cleanup is to be judged. Rather, Valley and GRC suggest herein that EPA's soil cleanup objectives for the Valley Site be dictated by the conditions that develop as the cleanup nears completion and monitoring reveals the actual equilibrium established.

The discussion of soil cleanup objectives in the Weston FS begins with a recognition that "[f]ederal regulations and guidance do not provide specific cleanup objectives that are applicable or relevant and appropriate for contaminated soils." Weston FS at 2-12. Likewise, no applicable or relevant and appropriate Massachusetts cleanup standards are cited. The Valley Site soil cleanup levels therefore are not based upon "applicable or relevant and appropriate" federal or state standards ("ARARs"). See §121(d) or CERCLA (42 U.S.C. §9621(d)).

The Weston FS next notes, based upon the Endangerment Assessment (Alliance, 1987), that "soil exposure routes were not used in establishing soil cleanup objectives, since no unacceptable risk is posed by current Site conditions or operation." Weston FS at 2-13. Accordingly, the cleanup objectives for soil are "'based on evaluation of the potential impact(s) on groundwater quality'". Weston FS at 4-4.

In order to determine the level of soil cleanup necessary to assure no adverse impact on groundwater quality (i.e., to permit maintenance of selected groundwater cleanup levels), Weston employs a formula utilizing the partitioning coefficients (K_{OC}) of the various VOC "contaminants of concern," an assumed fraction of organic carbon in the soil and the selected groundwater cleanup levels (the "Weston formula"). See Weston FS at 2-14. This calculation yields the expected concentration of the various VOCs in soils in contact with standing water, i.e., it yields soil concentrations for a static equilibrium. Such figures would describe accurately the equilibrium expected to exist between soil particles and associated moisture in the unsaturated zone. They do not accurately describe the dynamic equilibrium between soil VOC concentrations in the unsaturated zone and groundwater VOC concentrations in the saturated zone. The formula employed, therefore, is ill-suited to EPA's purpose.

The Weston formula fails to take account of at least two critical factors affecting the dynamic equilibrium between VOC concentrations in unsaturated zone soils and VOC concentrations in saturated zone groundwater. First, and most importantly, water that percolates through Valley Site soils contributes only a very small fraction of the groundwater present in the aquifer underlying the Site at any given point in time. The great majority of that water, of course, will have originated upgradient, off-site. By failing to account for groundwater movement, the Weston formula ignores a very significant dilution factor.

Furthermore, the Weston formula fails to account for the time required for equilibrium to be established between soil and water in the unsaturated zone. There is no basis for concluding that percolation of water through the unsaturated zone occurs at a sufficiently slow rate to permit the calculated equilibrium to be reached.

The expected cumulative effect of these two factors is that VOC concentrations in groundwater will be maintained at the desired levels notwithstanding substantially higher unsaturated zone soil VOC concentrations than those generated by means of the Weston formula. A simple examination of pertinent data confirms this expectation.

According to the Weston formula, the ratio of TCE soil concentration to TCE groundwater concentration should be 1.3:1. See Weston FS Table 2-1A (as corrected). A comparison of average TCE concentration values in the "source" region suggests that a higher ratio is appropriate. These ratios are shown in Table I.

TABLE I

WELL	VERTICALLY AVERAGED SOIL CONCENTRATION (ppm)	TEMPORARILY AVERAGED GROUNDWATER CONCENTRATION (ppm)	RATIO
TW-9	703	80.92	8.68
TW-16	30	3.44	8.72
TW-18	892[11]	66.90[12]	13.30
		Average:	10.24

The above analysis indicates that a ratio of about 10:1 for TCE more accurately reflect the equilibrium reached under the dynamic conditions actually prevailing at the Valley Site.

In view of the failure of the figures generated by means of the Weston formula to reflect accurately the dynamic equilibrium actually observed at the Site, a decision by EPA to treat those figures as immutable standards by which the success of vacuum extraction is to be judged would be wholly arbitrary and insupportable. A far more reasonable approach, sensitive to actual Site conditions, would be to treat the figures produced by the Weston formula as aspirational goals, with the proviso that, if those goals are not reached by the vacuum extraction system, groundwater monitoring will be conducted for a reasonable period of time to determine whether groundwater VOC concentrations are indeed increasing toward an equilibrium in excess of the selected

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11/ From estimate of volume of VOCs in unsaturated zone, Appendix A hereto.

12/ From estimate of volume of VOCs in saturated zone, Appendix E hereto.

groundwater cleanup standards. Only if such changes were in fact observed would there be any justification -- under EPA's own analysis -- for the performance of additional soil remediation.

C. Groundwater Cleanup - "High Rate" Groundwater Treatment

The preferred alternative includes a groundwater cleanup component referred to as "High Rate Groundwater Treatment." In outline, the envisioned treatment system would pump groundwater from a line of 14 recovery wells along the eastern boundary of the Valley Site at a combined rate of 30 gpm to be fed into an air stripping tower. Following air stripping treatment, 28.5 gpm of groundwater would be returned to the aquifer, upgradient of the extraction wells, through a set of reinjection wells, while 1.5 gpm would be reinjected -- after liquid phase carbon treatment -- downgradient of the Site. A total of 10 reinjection wells are contemplated, and air emissions from the air stripper are to be treated with vapor phase carbon. Weston FS at 3-7 to 3-8; Appendix B, Table B-5.

With certain significant exceptions discussed below, Valley and GRC do not contest EPA's determination that a groundwater pumping, treatment and recirculation system is an appropriate method for removing VOCs from the groundwater beneath the Valley Site. With respect to the design for this system described in the Weston FS, however -- particularly the 30 gpm pumping rate and the numbers of extraction and reinjection wells -- Valley and GRC take strong exception, both on grounds of need (in terms of the volume of VOCs to be removed) and technical implementability (in terms of the capacity of the aquifer to accept reinjected water without affecting the water table). Specifically, Valley and GRC will demonstrate (1) that the target cleanup levels for groundwater can be reached within 10 years (assuming technical feasibility) by means of a treatment system with a pumping rate of 3 gpm, if a reasonable estimate of VOC volume is employed, and (2) that a 30 gpm pumping rate cannot be used in any event since any pumping rate in excess of 7 gpm will cause flooding of the unsaturated zone and interfere with the vacuum extraction system.

1. Volume of VOCs in the Saturated Zone; Necessary Pumping Rate

As noted above, a critical factor in determining the appropriate design and expected operating costs of remedial facilities is the volume of "contaminant" the system will be required to remove. This is no less true for groundwater remediation than it is for soil remediation. While the Weston FS is strangely silent with respect to any estimate of the volume of VOCs in the saturated zone, its determination of a necessity of treatment for 10 years at a rate of 30 gpm reveals that, contrary to the NCP and 1988 Guidance, the data generated through the RI and SRI once again have been ignored. The result of this error is an unnecessarily elaborate groundwater treatment design, an excessive pumping rate and exaggerated operation and maintenance costs.

The authorities discussed in Section II.A.1., above establish that one purpose of the Lally RI and SRI properly should have been to define the extent or volume of VOCs in the saturated zone. The SRI Order confirms that, indeed, this was one purpose of the SRI, SRI Order, §6 at 4, and, indeed, sufficient data is available from which an estimate can be made.

The Weston FS, however, makes no reference to any such calculation. Perhaps this should not be surprising, in view of the fact that Weston assumes that all 3,000 gallons it estimates to have been discharged at the Site exist today within the unsaturated zone soils. Of course, Weston does not seriously contend that that is the case, since if it did, it could find no need for groundwater remediation. Moreover, since Weston has seen fit not to disclose the substance of the groundwater modelling it indicates it has performed, Weston FS at 3-7 to 3-8, this avenue is of no help in determining the saturated zone VOC volume assumed.[13/]

[13/] A rudimentary method of discerning the assumed volume is to apply a per-gallon carbon cost derived from the vacuum extraction cost estimate to the total carbon costs assumed for groundwater treatment. The vacuum extraction carbon cost estimate (initial and replacement) totals $708,370. Weston FS, Appendix B, Table B-2. As noted, this cost is based on recovering 3,000 gallons of VOCs. Thus, the per gallon carbon cost is $236.12. The groundwater treatment carbon cost estimate (initial and replacement) totals $208,000. Weston FS, Appendix B, Table B-5. At a per gallon cost of $236.12, this calculation yields an assumed saturated zone VOC volume of 881 gallons. If this or a figure of similar magnitude was used, then the expected costs announced in EPA's Proposed Plan are based upon the remarkable premise that 3,881 gallons of VOCs are expected to be recovered where only 3,000 gallons are estimated to have been released!

An estimation of the volume of VOCs in the Valley Site saturated zone based upon presently available data is presented in Appendix E to these comments.[14] According to that estimate, only about 11.5 gallons of VOCs (TCE and 1,2 trans-dichloroethylene) exist in the saturated zone within the property boundaries of the Valley Site. (A total of 99 gallons is estimated to be present in the entire plume.)

Appendix F presents (in the form of a letter to counsel) the results of computer modelling developed to determine the removal rate of VOCs under various assumed groundwater pumping rates (30, 15, 5 and 3 gpm). In each case, it is assumed that 1.5 gpm will be reinjected downgradient (accordingly, recycle rates are 28.5, 13.5, 3.5 and 1.5 gpm). In each case, a starting average VOC concentration of 100 mg/l (ppm) is assumed and the pore volume quoted in the Weston FS ($1.3x10^6$ gallons) is employed. (Thus, the model assumes a total Valley Site saturated zone VOC volume of 89 gallons, a figure far higher than the calculated volume.)[15]

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[14] Appendix E also presents an estimate of the total volume of VOCs in the "Valley Plume" as depicted in the 1985 ERT Groveland Wells Site Remedial Investigation Report, should off-site VOC volume be deemed relevant.

[15] To convert $1.3x10^6$ gallons of water at 100 mg/l VOC to a volume of VOC, the concentration must be converted to a volumetric basis by dividing the product of volume of water times the volumetric concentration ($1.3x10^6$ gallons * 100 mg/l) by the specific gravity of the VOC (taken in this case to be the specific gravity of TCE, 1.46 mg/ml). Thus the volume

(Footnote Continued on Next Page)

The model predicts that a *3.0* gpm pumping rate (1.5 gpm recycle rate) will reduce total VOCs in the groundwater to 1 ppb (assuming technical feasibility) *within the 10-year period preferred by EPA*. By contrast, a 30 gpm pumping rate is predicted to achieve VOC cleanup goals *within one year*. For purposes of comparison only, a preliminary cost estimate for the 3 gpm system also is presented. Appendix F, Table 5. The expected total cost for the 3 gpm system, including operation and maintenance, is about *one fifth* of the cost estimated for the 30 gpm system in the Weston FS.[16]

The foregoing analysis, together with the referenced appendices, demonstrates that the Weston FS has grossly overestimated the rate of extraction of groundwater necessary to achieve the selected groundwater cleanup target levels within ten years. Furthermore, it has been shown that a scaled-down 3 gpm treatment system can achieve EPA's goals, within EPA's time frame, at about one-fifth the cost of the 30 gpm system described in the Weston FS. In such

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15/ (Footnote Continued from Previous Page)

of VOC will be:

$$V = \frac{1.3 \times 10^{6} \text{ gallons} * 100 \text{ mg/l}}{1.46 \ ^{\text{mg}}/\text{ul} * 10^{6} \ ^{\text{ul}}/\text{l}}$$

$$V = 89 \text{ gallons}$$

[16] The groundwater treatment system design described in Appendix F assumes, for argument purposes only, that carbon treatment of air stripper vapor emissions may properly be required. As noted in Section III.C.3., below, Valley and GRC question the authority of EPA to impose such a requirement.

circumstances, a decision to select the 30 gpm system would be wholly arbitrary and inconsistent with the NCP. See 40 C.F.R. §300.68(i).

2. Technical Practicability of 30 GPM Treatment System

Even if the installation and operation of a 30 gpm groundwater treatment system could be justified as a matter of cleanup goals (which it cannot) the employment of such a system nevertheless would have to be rejected as technically impracticable, since any recycling rate in excess of 7 gpm will cause the groundwater table to rise substantially and interfere with the operation of the vapor vacuum extraction system in the unsaturated zone.

In August 1985, Lally conducted a pump test at the Valley Site during which test wells TW-19, TW-20, TW-21 and TW-22 were employed as injection wells and groundwater elevations were recorded in a number of other wells at the Site, including the wells located in the storage area. The results of the pump test are set forth in Table VI-1A of the Final Lally SRI Report.

During the test, groundwater levels rose sharply at injection rates exceeding 7 gpm. For example, in the storage shed area, groundwater levels rose over 5' (TW-9, TW-18). At TW-15, groundwater rose over 12'. Moreover, groundwater levels had not completely stabilized when the injection rate was reduced, so equilibrium levels may be somewhat higher. An injection rate of

30 gpm (more than four times the magnitude of the rate of the 1985 pump test) could result in groundwater levels above the clay lens where the highest TCE concentrations have been detected.

Since a 30 gpm pumping rate will cause a dramatic rise in the water table, flooding the unsaturated zone at the Site, and interfering with the operation of the vacuum extraction system, the "high rate" groundwater treatment system described in the Weston FS must be rejected as technically infeasible.

3. Carbon Treatment of Air Stripper Vapor Emissions

The groundwater treatment system design presented in the Weston FS includes the use of carbon columns to treat vapor emissions from the air stripper. It is presumed that this requirement has been imposed based on the purported applicability of a "performance standard" limiting ambient air concentrations of VOCs. Valley and GRC submit that EPA lacks authority to impose this requirement since no federal air emission limitation, and no promulgated Massachusetts air emission limitation is applicable to the air stripper proposed to be installed at the Valley Site.

While referring generally to the federal Clean Air Act and to Massachusetts air emissions regulations (310 CMR §§6.00-7.00), the Weston FS fails to cite to any air emission limitation specifically applicable to VOC emissions from the operation of an air stripping tower. Weston FS at 2-7 to 2-8; 2-11. Valley and GRC are unaware of any such standard under the Clean Air Act and can find no limitation in 310 CMR §§6.00-7.00 which appears to be applicable to an air stripping unit.

In light of the foregoing, Valley and GRC can only conclude that the vapor phase carbon adsorption step in the preferred groundwater treatment design is based on the purported applicability (or "appropriateness") of an unpublished set of air emission "limitations" known as "Allowable Ambient Levels" ("AAL"), which apparently are maintained by the Massachusetts Department of Environmental Quality Engineering. Since those AALs have not been published in the Massachusetts Register or the Code of Massachusetts Regulations, it is submitted that they do not have the force of law and cannot be imposed upon Valley and GRC as "legally applicable" standards. See CERCLA §121(d)(2)(A) (42 U.S.C. §9621(d)(2)(A)).

Furthermore, it is submitted that EPA is without authority to impose a requirement of compliance with AALs on the basis that they are "relevant and appropriate." Under §121(d)(2)(A)(ii) of CERCLA, a state "standard, requirement or limitation" may be imposed as "relevant and appropriate" only if it has been "promulgated." See 42 U.S.C. §9621(d)(2)(A)(ii). Since the AALs have not been promulgated, CERCLA does not furnish EPA with authority to require carbon treatment of air stripper vapor emissions in order to conform to AALs for VOCs.[17]

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[17] A second concern of Valley and GRC with respect to the design of the groundwater treatment system is its failure to exploit the potential of the air stripper already operating at Mill Pond to further contribute to groundwater cleanup. Valley and GRC request that EPA give further consideration to this option.

III. INORGANIC CHEMICALS

As noted at the outset of these comments, the Weston FS did not address the sporadic detection at the Valley Site of minute concentrations of the inorganic chemicals arsenic, cadmium, chromium, copper and lead (collectively, "the inorganics"). This was a consequence of the fact that the original Endangerment Assessment ("EA") (Alliance, 1987) declined to designate the inorganics as "contaminants of concern" due to "their low concentrations and low frequency of detection." Weston FS at 1-22.

Apparently dissatisfied with the conclusion of the Alliance EA, EPA first determined that the five inorganics would in fact be designated as "contaminants of concern" and then commissioned Camp, Dresser & McKee, Inc. ("CDM") to prepare an "amendment" to the EA ("Draft Amendment to the Valley Manufactured Products Company Endangerment Assessment," CDM, 1988) purportedly re-evaluating Valley Site public health risks, taking into account the inorganics. Finally, EPA, in its August 17, 1988 letter to counsel, selected groundwater target cleanup levels for the inorganics. As of the drafting of these comments, no soil cleanup target levels had been selected for the inorganics and no particular approach to any cleanup of the inorganics in soils had been discussed or selected.[18]

The discussion below will demonstrate that the conclusion of the Alliance EA was correct: there is no sound basis for designating the inorganics as "contaminants of concern." It will be shown that the CDM amendment to the Alliance EA in fact supports the conclusion drawn by Alliance, and not that of EPA. Finally, it will be demonstrated that EPA lacks authority to impose upon Valley and GRC the chosen cleanup targets for the inorganics, both because observed concentrations do not in fact exceed background levels and because CERCLA does not authorize EPA to treat *proposed* regulations as ARARs.

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[18] As to the remedial approach for the inorganics in groundwater, the August 17 letter states that "EPA's preferred alternative involves removing and treating groundwater for VOCs which would, by design, involve any necessary oil phase separation and inorganics treatment." As discussed below, however, results of recent sampling indicate that oil phase separation will not be required, since no oil or grease separation was detected in the sampled wells. *See* Appendix G.

A. *The Alliance EA and EPA's Response*

The Alliance EA declined to list the inorganics as "contaminants of concern" because (1) the concentrations detected did not exceed expected background levels described in current literature, and (2) inadequate analysis of inorganics had been performed in prior investigations. Alliance EA at 2-7. Despite these conclusions, *and before the results of any additional inorganics analysis of Valley Site samples were available*, EPA decided to designate the inorganics as "contaminants of concern." EPA's purported reasons for rejecting its own contractor's conclusion were (1) that the Alliance EA did not calculate so-called "indicator scores" for the inorganics, and (2) that Alliance incorrectly focused on two monitoring wells, GZ-2 and GZ-3, which EPA found not truly "representative" of Site conditions. CDM Amendment at 1. The conclusions of the Alliance EA were correct; EPA's objections are wholly without merit.

The conclusion of the Alliance EA has been borne out by inorganics analysis conducted on samples taken on August 4, 1988 from monitoring wells *selected by EPA* for the purpose of characterizing more completely the distribution of inorganics at the Site. *See* SRI Order, Modification No. 1, Task 1. Appendix G presents the results of this sampling round. Four of the five selected inorganics (arsenic, cadmium, chromium and copper) either were not detected at all or were detected only at concentrations below the selected target levels.[19] As to lead, which was detected in only two of the seven sampled wells and exceeded the current MCL at those two wells by only .01 and .03 ppm, Alliance's conclusion that background has not been exceeded remains intact.[20]

EPA's objections to the Alliance conclusions, by contrast, are extremely weak. First, there is no requirement that "indicator scores" be developed for all HSL chemicals detected at a site. EPA's Superfund Public Health Evaluation Manual (1986) (the "Manual") expressly states that "EPA recognizes that other approaches [i.e., other than that discussed in the manual] may be equally valid." Manual at 4. As stated in the CDM Amendment, Alliance's selection of "contaminants of concern" was based on "consideration of the relative importance of a contaminants' inherent toxicity, measured concentrations at the site, and physical and chemical parameters related to environmental mobility and persistence of each chemical.'" CDM Amendment at 1. Surely EPA does not contend that such an approach is inappropriate.

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[19] Based on these results, and in view of the historic pattern of infrequent detection of minute concentrations of these four inorganics, arsenic, cadmium, chromium and copper should be removed from the list of "contaminants of concern," even if EPA's endangerment analysis for the inorganics is in all other respects valid (which it is not).

[20] Even if the reported lead concentrations in TW-8 and TW-17 exceed "global" groundwater background levels, it should be noted that both of these wells are in the area of the MDC oil/gas separator and leaching field, which collects and distributes run-off from Washington Street. The lead concentrations detected in TW-8 and TW-17 are within typical urban runoff parameters.

Amendment serves only to underscore the correctness of the Alliance conclusion.[22]

In discussing the hazard from possible ingestion of "carcinogens" in groundwater, the CDM Amendment is careful to note that "arsenic levels found in soils of the Valley Site are within the background range for New England soils." CDM Amendment at 25. Similarly, in discussing hazards resulting from ingestion of the "non-carcinogens" in groundwater, the CDM Amendment states that exceedence of a hazard index of 1 was "mostly attributable to trans-1,2-dichloroethene." CDM Amendment at 9. The message is clear that reduction of concentrations of trans-1,2-dichloroethene alone to the selected VOC target level will reduce the hazard index to an acceptable level.

Furthermore, the CDM Amendment takes a giant step backward in failing to consider (1) the absence of any evidence of migration of the inorganics, and (2) the real-world probability that a drinking water well will be installed in the area where lead has been detected, a matter of a few feet from the manufacturing plant, adjacent to the MDC manhole and oil/gas separator. On the first point, there simply is no evidence of migration of the inorganics on-site, let alone off-site. Given this fact, based on the analysis results presented in Appendix G, the only risk to be evaluated is that of a person installing a drinking water well adjacent to TW-8 or TW-17 at the Valley Site, the probability of which is next to zero.

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[22] It is difficult to discern the purpose served by the CDM Amendment. Its purpose apparently was not to determine whether the inorganics should be designated "contaminants of concern," since this was a fait accompli before its preparation. CDM Amendment at 1. Nor did it generate target cleanup levels for the inorganics. The selected levels are stated in the August 17 letter to be based solely upon MCLs, proposed MCLs and proposed MCL Goals. One is compelled to conclude that the CDM Amendment is little more than a post-hoc justification of a decision already made.

The CDM Amendment, if it serves any purpose at all, merely confirms that the inorganics should not have been selected as "contaminants of concern."

C. Selected Target Levels

EPA's August 17 letter establishes groundwater cleanup target levels for the selected inorganics based upon MCLs for arsenic and chromium (which are not being exceeded at the Site (*See* Appendix G)) and upon *proposed* MCLs for copper and lead and a *proposed* MCL Goal for cadmium. Since the target levels for copper, lead and cadmium are based neither upon a site-specific hazard assessment nor upon ARARs, EPA has no authority to enforce them.

Section 121(d) of CERCLA authorizes EPA to establish cleanup target levels based on "any standard, requirement, criteria or limitation under any Federal environmental law, including . . . the Safe Drinking Water Act . . .," 42 U.S.C. §9621(d)(2)(A)(i), if the

Second, EPA's position that monitoring wells GZ-2 and GZ-3 are not "representative" is irrelevant to the soundness of Alliance's conclusion. Alliance simply did not rely solely upon GZ-2 and GZ-3 in concluding that the inorganics ought not to be designated "contaminants of concern." Alliance EA at 2-7.

The sampling round recently conducted for the express purpose of generating an improved database for inorganics in groundwater at the Site demonstrates that the conclusion of the Alliance EA was correct; the selected inorganics should not be designated as "contaminants of concern."[21]

B. The CDM Amendment

After erroneously concluding that the Alliance EA was flawed by its decision not to select the inorganics as "contaminants of concern," EPA commissioned CDM to amend the EA accordingly. The CDM standard or limitation is either applicable or relevant and appropriate. 42 U.S.C. §9621(d)(2)(A). SDWA authorizes EPA to promulgate regulations, by means of appropriate administrative procedures, fixing MCLs and MCL Goals for drinking water. Until the administrative procedure is complete, however, a proposed MCL or MCL Goal cannot be a "standard . . . or limitation . . . under [SDWA]." To hold otherwise is to deny the role of the review and comment process in establishing regulations. CERCLA cannot be interpreted in a manner so fundamentally inconsistent with the Administrative Procedures Act.

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[21] As to soil, the inorganics analysis performed on samples taken from TW-26 as part of the SRI show soil concentrations of the five selected inorganics at or below current MCLs. Lally SRI, Appendix C, Soil Analytical Data. These results are hardly supportive of EPA's decision to designate the five selected inorganics as "contaminants of concern." Results of additional soil sampling, which Valley and GRC have agreed to perform as part of the vacuum extraction treatability study, are not yet available.

Since the cleanup levels for copper, lead and cadmium were selected ~~by~~ EPA based on standards which are merely "proposed," and which have not been adopted or followed, EPA lacks authority to impose such levels and must not make them a part of its Valley Site Record of Decision.

D. Cleanup of Inorganics

Since the Proposed Plan does not select remedial alternatives for cleanup of the inorganics at the Valley Site, Valley and GRC obviously can make no comment on any such potential remedies. At such time as EPA does propose a remedy or remedies, if any, addressing the inorganics, Valley and GRC expect and demand that they will be accorded an opportunity to submit comments, pursuant to Sections 113(k)(2)(B)(ii) and 117(a)(2) of CERCLA. 42 U.S.C.

§§9613(k)(2)(B)(ii), 9617(a)(2). For present purposes it will suffice to state that, based on presently available data, EPA's course of action with respect to inorganics at the Site should be "no action." See NCP §300.68(f)(1)(v) (40 CFR §300.68(f)(1)(v)).

TERRA VAC PARTIAL PROJECTS LIST

VACUUM EXTRACTION

SITE	TYPE	DATE START	DATE END	COMPOUND	AREA (ft^2)	DEPTH TO GROUNDWATER	SOIL TYPE	PERMEABILITY	CLEANUP GOAL	INITIAL RECOVERY RATE	STATUS	TREATMENT
TYSONS	SUPERFUND	NOV 86	NOV 86	TCP PCE TCE XYLENES TOLUENE BENZENE	750	18'	CLAY	LOW	PILOT TEST	28-102 lbs/day	PENDING	CARBON ADSORPTION
BARCELONETA SPILL	SUPERFUND	NOV 82	NOV 86	CCL4	600,000	300'	1. CLAY 2. ROCK	LOW HIGH	ND	250 lbs/day	ACHIEVED GOALS	CONDENSATION DISPERSION
VERONA SUPERFUND MICHIGAN	CONCEPTUAL DESIGN	JUN 85	AUG 85	SOLVENTS	7,000	17'	SAND/SILT	MED	1ppm	N/A	EPA ROD	CARBON ADSORPTION
SOUTH CAROLINA	INDUSTRIAL	OCT 86	ON GOING	PCE	12,000	12-20'	CLAY	LOW	ppb level	100 lbs/day	ON GOING 90% CLEANUP	DISPERSION
MICHIGAN	INDUSTRIAL	DEC 86	ON GOING	TCE PCE	34,000	35'	SAND	HIGH	DRINKING WATER STANDARD	30-80 lbs/day	ON GOING 90% CLEANUP	CARBON ADSORPTION
PUERTO RICO	MAJOR OIL	JUL 85	AUG 85	BENZENE GASOLINE	18,000	11'	SILT/SAND	MED	1 gal/day	2000 lbs/day	GOAL ACHIEVED	DISPERSION
PUERTO RICO	GAS STATION	JAN 85	AUG 85	BENZENE TOLUENE XYLENES COMBUSTIBLES	3,000	2-11'	CLAY/SILT	LOW	NO COMBUSTIBLES	300 lbs/day	GOAL ACHIEVED	SEPARATION
BELLEVIEW FLORIDA	GAS STATION	JAN 86	FEB 86	BENZENE TOLUENE XYLENE	6,000	50'	CLAY/SAND ROCK	LOW HIGH	DEMONSTRATE CLEANUP	2000 lbs/day	DEMONSTRATED EFFECTIVE ON GOING CLEANUP	SEPARATION DISPERSION
MANATI PUERTO RICO	INDUSTRIAL UNDERGROUND TANKS	DEC 84	FEB 85	HEXANE DMF THF ACETONE	3,000	13'	SAND	HIGH	CLEANUP	400 lbs/day	EFFECTIVE CLEANUP ON GOING MONITORING	SEPARATION DISPERSION
PUERTO RICO	GAS STATION	JUN 86	JUL 86	BENZENE GASOLINE	5,400	40'	SILT/SAND	MED	ND	1300 lbs/day	GOAL ACHIEVED	DISPERSION
DUPONT DEPT OF ENERGY	GOV'T	MAR 86	ON GOING	PCE TCE	20,000	130'	CLAY SAND	LOW HIGH	PILOT	250 lbs/day	ON GOING	DISPERSION

Ri = Radius of Influence

TERRA VAC
4897-J WEST WATERS AVE., TAMPA, FLORIDA 33634 ■ TEL. (813) 885-5374

August 31. 1988

Mr. Martin Pontz
Attorney
Valley Manufactured Products
Groveland. Mass.

RE: Radius of Influence
Valley Manufactured Products
Terra Vac Project #88-405

Dear Mr. Pontz:

Regarding your request for information on the radius of influence of vacuum extraction wells at Valley we can be confident that the radius of influence extends at least 35 feet at the open field area outside the building and extends substantially further in the area beneath the building. This is based on our extensive experience at applying this technology at more than 30 sites across the country (see enclosed partial list) and our experience with the site specific subsurface conditions at Valley and successful implementation of the vacuum extraction system at Valley.

If you have any questions, please contact our firm at your convenience.

Very truly yours.

TERRA VAC

James J. Malot, P.E.
President

cc: Joe Pezzullo

APPENDIX A

ESTIMATION OF VOLUME
OF VOCs IN THE VALLEY SITE
UNSATURATED ZONE

Section I: Introduction

The Lally Remedial Investigation (RI) and Supplementary Remedial Investigation (SRI) reports contain compilations of soil sampling data and soil gas sampling data which permit calculation of an estimated volume of TCE in the Valley Site unsaturated zone, including TCE that is sorbed to soil particles as well as TCE which exists in vapor phase in the interstitial spaces. Since TCE is the major volatile organic compound (VOC) detected at the Valley Site, a calculation of the volume of TCE in the unsaturated zone yields a fair approximation of the total volume of VOCs at the Valley site to be recovered through soil vapor vacuum extraction.

The analysis set forth below separately considers the volume of TCE presently existing in (1) the area beneath and adjacent to the southeast corner of the Valley building where soil borings have been advanced and soil analytical data therefore are available, and (2) the area beneath the Valley building for which no soil borings have been advanced. (Other areas of the Valley Site have been excluded based on soil gas sampling failing to detect significant concentrations of TCE.) In those areas where soil borings have not been advanced and soil analytical data therefore are absent (Area 2), soil TCE concentrations are calculated by reference to soil gas data and soil gas to soil distribution coefficients. Where soil sampling data are available (Area 1), soil concentrations are based on such data.

Section 2: Estimation of Volume of TCE in the Valley Site Unsaturated Zone in the Southeast Region of the Valley Building

Calculations were performed to determine the quantity of TCE in the unsaturated zone in the area of the Valley Site for which soil analytical data are available. The calculation described below estimates the quantity of TCE in the region near the southeast side of the building, where soil borings have been advanced and soil samples analyzed. To accomplish this task, chemical analyses of soil from borings made at the site were used to develop a profile of TCE concentrations. These data were collected from the following sources:

- The 1985 Lally RI Report.
- Draft report of GC/MS purge and trap data collected in the course of EPA's SITE vacuum extraction project. March 1988. (These data are expected to be available in final, validated form about September 20, 1988.)

The samples from the various borings were obtained over a period of several years. To perform this calculation, an assumption was made that the soil concentrations did not vary significantly during this time.

RESULTS:

The total mass of TCE in the unsaturated zone beneath this region is estimated to be 684 kg (as shown in Table 2-1.). This converts to 1505 pounds, which in turn converts to 124 gallons. Thus, 124 gallons of TCE would have to be present in the soil to

11

account for the observed concentrations.

METHOD:

The region covered by this calculation is depicted in Figure 2-1. This region was broken into triangular sub-regions or "elements". The corners (or "nodes") of these triangles were chosen to coincide with the locations of the soil borings completed in this area. The quantity of TCE in the soil within each element was estimated by multiplying the volume of soil beneath the triangle by an average concentration of TCE in that volume. Soil volumes were determined by multiplying the triangle area by an average depth to the water table. These volumes are listed in Table 2-1. The average depth was determined by averaging the reported values for each of the soil borings. This depth is 38.3 feet.

An average TCE concentration for each element was determined by first calculating an average soil concentration for the boring at each node, and then averaging these three nodal concentrations. The nodal average concentration was determined by a simple arithmetic mean of the measured concentrations at various depths. For depth intervals where measured soil concentrations are not available, soil concentrations were assigned. Assigned concentrations were estimated by choosing the highest concentration of the two adjacent depth intervals. For example, if the measured concentration in the depth interval 0 - 2 feet in boring B-8 was 610 ppm, and the concentration in interval 5 - 8 feet was 1600 ppm, then the interval 2 - 5 feet was assigned a concentration of 1600 ppm. This estimate most likely biases the overall calculation to show a greater quantity of TCE than is actually present. Table 2-2 presents the average concentrations for each of the nodes.

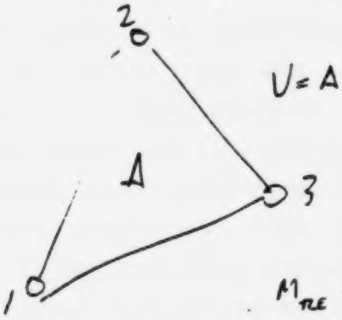
The average TCE concentration for each triangular element was then determined by calculating the geometric mean of that element's nodal concentrations. This mean is defined as:

$$C_{avg} = (C_1 * C_2 * C_3)^{1/3}$$

These values are presented in column 4 of Table 2-1.

The last column of Table 2-1 lists the mass of TCE in each element. These values were calculated by multiplying an element's volume (m^3) by its average concentration (mg TCE/kg soil) and the bulk density of the soil (2000 kg/m^3).

$$C_{Avg} = \left[(C_1)(C_2)(C_3)\right]^{1/3}$$



$V = A \times 38.3'$

$M_{TCE} = (V_\Delta)(C_{AVG})$

$$C_{AVG_1} = \left(\frac{100+1000+1600}{3}\right) = 900 \text{ mg/kg}$$

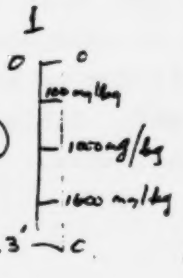


FIGURE 2-1 MAP OF TRIANGULAR ELEMENT DISCRETIZATION OF THE SOUTHEAST REGION OF THE BUILDING

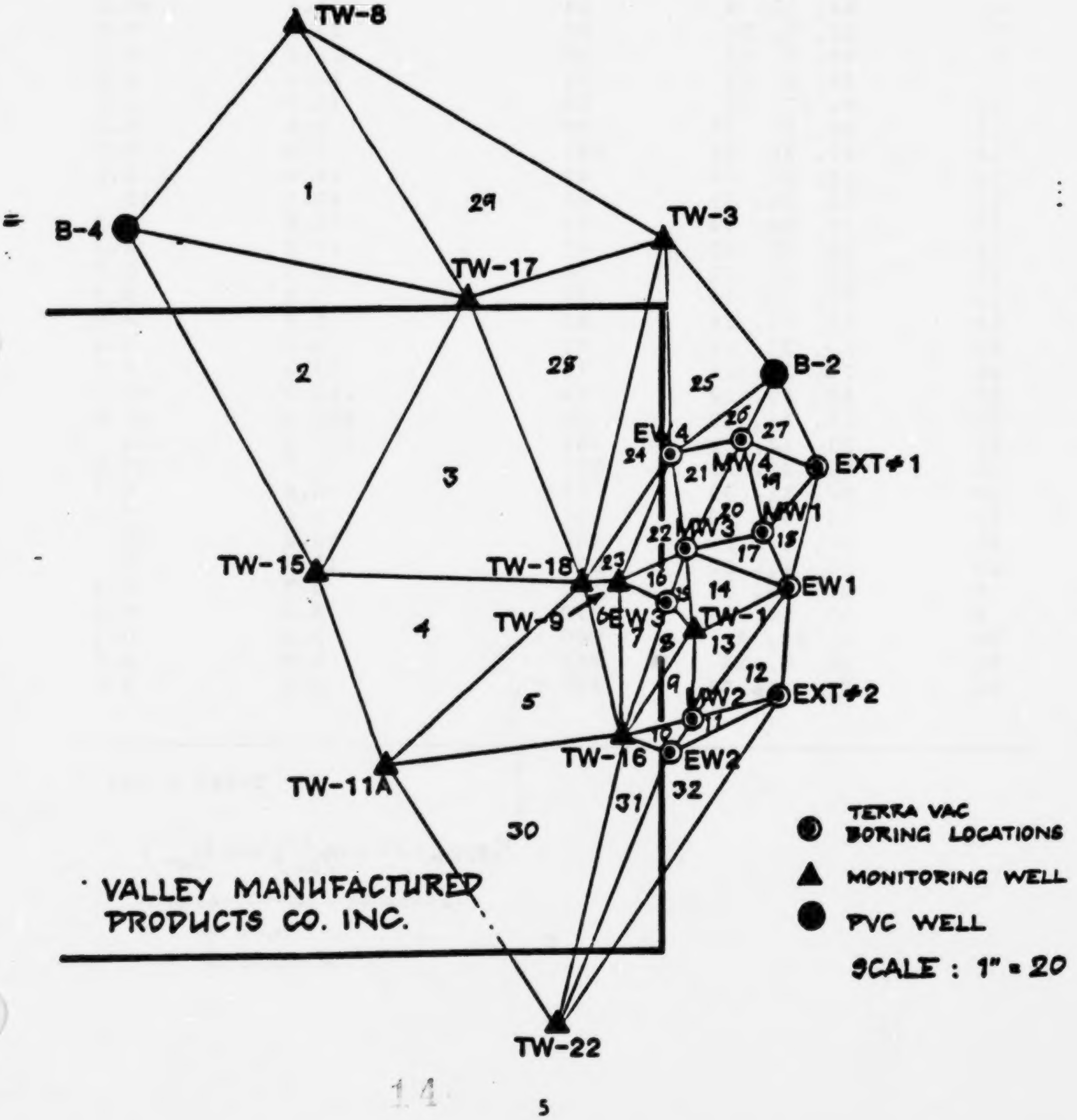

TW-8
1
29
B-4
TW-3
TW-17
2
28
25
B-2
EW4
26
27
24
21
MW4
EXT#1
19
3
20
MW1
22
MW3
18
17
TW-15
TW-18
23
16
15
14
EW1
TW-9
6
EW3
TW-1
4
7
8
13
12
9
5
MW2
EXT#2
11
10
TW-16
EW2
TW-11A
31
32
30
VALLEY MANUFACTURED PRODUCTS CO. INC.
TW-22
TERRA VAC BORING LOCATIONS
MONITORING WELL
PVC WELL
SCALE : 1" = 20

Table 2-1
Calculation of the Quantity of TCE in Each Element

Element	Node	Volume (m^3)	TCE Geometric Mean Conc. (mg/kg)	Total (kg TCE)
3	7, 16, 14	1000	33.5	67 = 1000
4	7, 3, 14	700	36.4	51
5	3, 14, 9	534	62.2	66.4
6	14, 13, 9	83	266.0	44.2
7	13, 9, 28	92	50.2	9.2
8	28, 9, 12	59	20.2	2.4
9	12, 9, 27	74	26.8	4.0
10	9, 27, 35	26	11.9	0.6
11	26, 27, 26	36	3.8	0.3
12	27, 35, 29	141	7.8	2.2
13	12, 27, 29	92	28.0	5.2
14	12, 30, 29	94	69.1	13
15	12, 28, 30	30	38.8	2.3
16	13, 28, 30	41	96.2	8.0
17	29, 30, 31	50	19.3	1.9
18	29, 31, 34	51	3.2	0.3
19	31, 33, 34	93	1.0	0.2
20	30, 31, 33	92	6.0	1.1
21	30, 32, 33	78	27.3	4.3
22	13, 30, 32	88	242.4	42.7
23	13, 14, 32	63	392.0	49.4
24	21, 14, 32	263	191.5	101
25	36, 21, 32	287	28.7	16.5
26	36, 32, 33	51	6.6	0.7
27	33, 34, 36	94	1.4	0.3
28	14, 16, 21	832	80.0	133
29	16, 21, 20	936	15.9	30
1	20, 16, 37	1100	3.7	8.1
2	37, 16, 7	1350	3.5	9.5
30	3, 38, 9	900	3.3	5.9
31	38, 9, 26	250	4.9	2.5
32	35, 38, 26	325	1.4	0.9

Total = 684.1

$(325\ m^3)(1.4\ mg/kg)(2000\ kg/m^3)$

$(650{,}000)1.4 = 260{,}000.0 + 650000$

$= 910{,}000$ mg.

$= 0.910$ kg.

Table 2-2

Average Concentrations at Element Nodes

Node	Boring Name	Average Soil Concentration (ppm)
3	B-11	9
7	TW-15	6
9	TW-16	30
12	B-1	46
13	B-9	703
14	TW-18	892
16	TW-17	7
20	B-8	7
21	B-3	82
26	EW 2	4
27	MW 2	14
28	EW 3	6
29	EW 1	34
30	MW 3	211
31	MW 1	1
32	EW 4	96
33	MW 4	1
34	EX 1	1
35	EX 2	1
36	B2	3
37	B4	1
38	TW-22	1

Section III: Estimation of Volume of TCE in the Valley Site Unsaturated Zone in Areas Beneath the Valley Building Where No Soil Borings Have Been Advanced

In the area under the Valley building where no soil borings have been advanced, the amount of TCE present in unsaturated zone soils can be estimated by reference to the soil gas concentrations beneath the building slab and the equilibrium relationship between soil gas concentrations and soil concentrations. This calculation was performed as described below utilizing the soil gas data contained in the Lally SRI report and soil analytical data from the Lally RI report.

RESULTS

The total mass of VOCs estimated to be present in the soil gas beneath the Valley building (in areas where no soil borings have been advanced) is 155 grams, about equal to 5 ounces.

Based on equilibrium considerations, the total volume of TCE estimated to be sorbed to soil particles in the unsaturated zone beneath Valley building (in areas where no soil borings have been advanced) is 13.8 gallons.

METHOD

An equilibrium condition exists between TCE adsorbed to the soils and TCE in the soil gas beneath a relatively impermeable surface such as the concrete slab of the Valley building. Determination of this partitioning coefficient (i.e. the ratio between soil gas concentration and soil concentration) allows one to use soil gas data to estimate the mass of TCE under the building where no soil boring data exists.

This ratio was determined by comparing soil gas measurements and the chemical analyses of soil samples from borings TW-15 and B-11 which are the closest to the area being estimated by this method. This comparison is presented below.

Boring Identification	TW-15	B-11
Mean soil TCE in ppm (mg/kg) (from Table 2-2)	6	9
Mean soil DCE concentration in ppm (calculated as for TCE)	0	1
Total Soil concentration TCE, DCE in ppm	6	10
Mean of soil gas concentration TCE, DCE in ppm at points 28, 29, 30 (area of TW-15)	293	---
Mean soil gas concentration TCE, DCE in ppm at points 15, 15R, 29, C2 (area of B-11)	---	296
Ratio of soil gas concentration (ppm) to soil concentration (ppm)	49:1	30:1

The average of these ratios yields an equilibrium partition coefficient of 39.5.

This partition coefficient can be used to estimate the likely concentration of TCE in unsaturated zone soil at the Valley Site for each point at which soil gas was collected and analyzed. It is assummed that, because the soil has been covered by the concrete building slab for about 15 years in most areas, the soil and soil gas are in equilibrium.

Figure 3-1, a plan of the Valley building, depicts and identifies by assigned number all soil gas sampling points in the vicinity of the Valley building. Figure 3-2 indicates for each sampling point shown in Figure 3-1 the total concentrations of TCE and dichloroethylene (DCE) detected during sampling in August and October, 1987. Finally, Figure 3-3 depicts the discretization of the area for which soil concentrations were estimated based on soil gas analysis results. As shown in Figure 3-3, the soil gas sampling points within the building were used as nodes to plot triangular areas for which geometric mean concentrations were calculated for both soil gas and soils.

NOTE: Soil gas concentrations utilized were averages of two values where the soil gas sampling point was sampled twice. The concentrations of TCE and DCE (dichloroethylene - the anaerobic biodegradation product of TCE) in the soil gas were expressed as TCE. This sum was then used to calculate the amount of TCE and DCE in the soil.

Table 3-1 sets forth the nodes of each triangular area, the volume of soil beneath each area to a depth of 29 feet (the average water table depth in July 1988 in nearby wells #15, 11, 16, and 23) and the corresponding soil weight and soil gas volume at 25% porosity. Column 7 lists the geometric mean soil gas concentration calculated for each triangular area, followed by the total volume of VOCs calculated to be in each area. The total volume of VOCs in the entire area is 0.37 cubic meters of TCE vapor which is equal to 155 grams of TCE liquid or about 5 ounces.

Similarly, Table 3-2 sets forth the same triangular areas and soil volumes and the estimated soil concentrations which were calculated by application of the soil gas/soil partition coefficient of 39 as the following example indicates:

For triangular element #8, mean soil gas conc. = 194 ppm TCE, DCE

$$\frac{\text{Soil Gas ppm}}{\text{Soil Conc. ppm}} = \frac{39}{1} = \frac{194}{\text{Soil Conc.}}$$

therefore, $\text{Soil Conc.} = \frac{194}{39} = 5 \text{ ppm}$

These estimated soil concentrations were multiplied by the mass of soil in each triangular area (to the unsaturated depth of 29 feet) to obtain the mass of TCE + DCE (VOCs) in each area, the results of which are shown in the last column of Table 3-2. Finally, all amounts were totaled, the result being 76 kg of TCE/DCE = 13.8 gallons.

Laboratory Experiment

To validate the soil gas to soil partition coefficient of 39, a laboratory experiment was designed and performed. The data and calculations shown in Table 3-3 are the result of this experiment designed to measure soil gas and soil concentrations under controlled laboratory conditions similar to that under the Valley building.

Procedure - Clean soil from the Valley Site was placed in vials. Known amounts of TCE were then deposited onto the soils and the vials were capped immediately. After waiting 2 days for the TCE to reach equilibrium, the headspace of each vial was analyzed for TCE. Following this analysis, TCE in the entire contents (soil and soil gas) was extracted with methanol and analyzed for TCE. This information allows one the calculate the soil concentrations and the corresponding soil gas/soil concentrations ratios as shown in Table 3-3. The ratios obtained by this experiment were 91:1, 282:1, and 73:1.

The entire range of soil gas/soil partitioning coefficients measured by various means is: 30, 49, 73, 91 and 282. Therefore, the value of 39 from borings B-11 and TW-15 appears to be a reasonable but conservative choice for use in calculating estimated soil concentrations from measured soil gas concentrations.

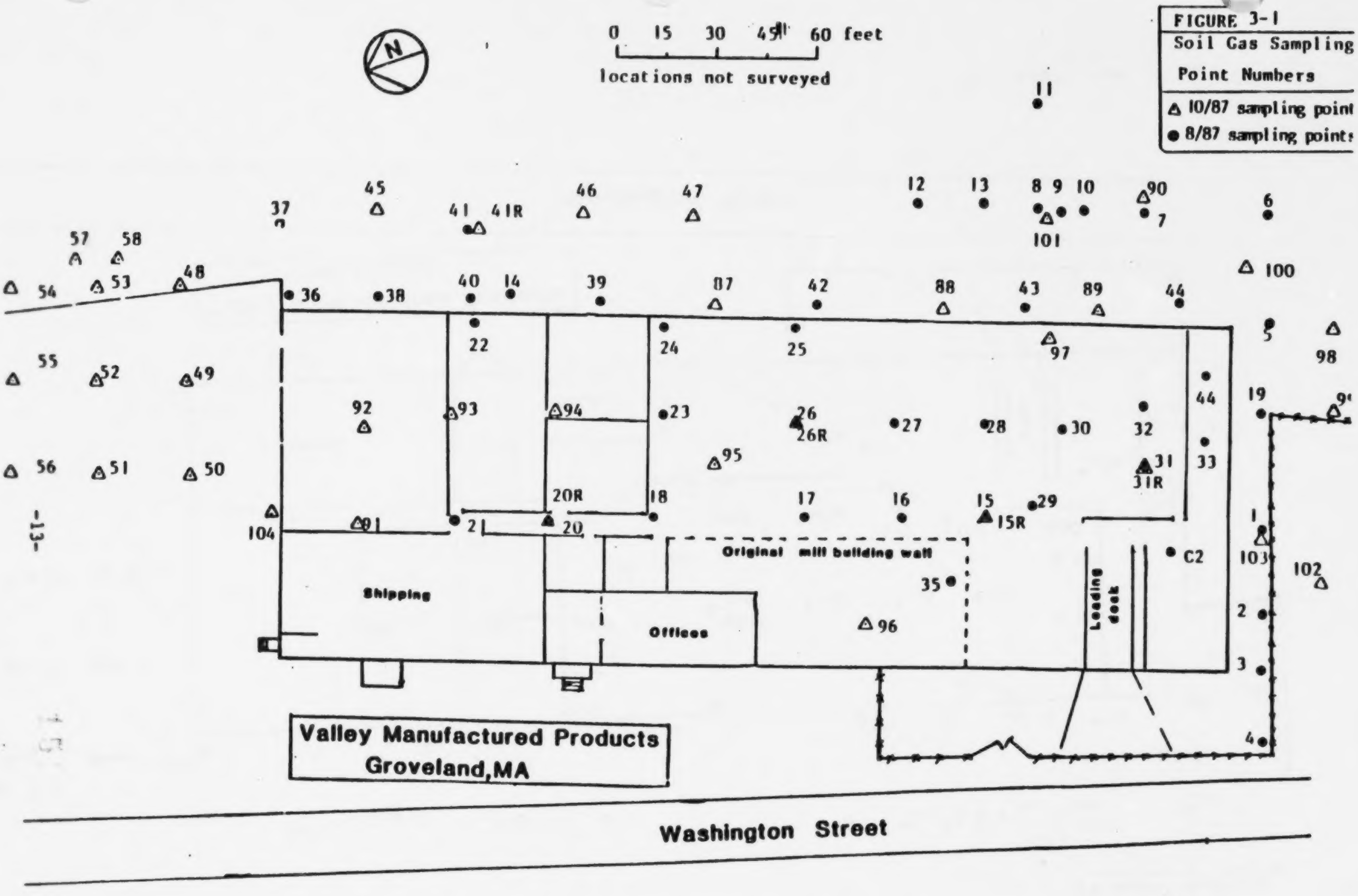


FIGURE 3-1
Soil Gas Sampling Point Numbers

△ 10/87 sampling point
● 8/87 sampling points
N
0 15 30 45 60 feet
locations not surveyed
Valley Manufactured Products
Groveland,MA
Washington Street
Shipping
Offices
Original mill building wall
Loading dock
54
55
56
57
58
53
52
51
48
49
50
37
36
38
45
41
41R
40
14
22
92
93
91
104
46
39
94
20R
20
21
47
87
24
23
18
95
42
25
26
26R
17
27
16
12
13
8 9 10
101
11
88
43
28
15
15R
29
97
89
30
90
7
44
32
31
31R
33
C2
35
96
6
100
5
98
19
99
1
103
102
2
3
4

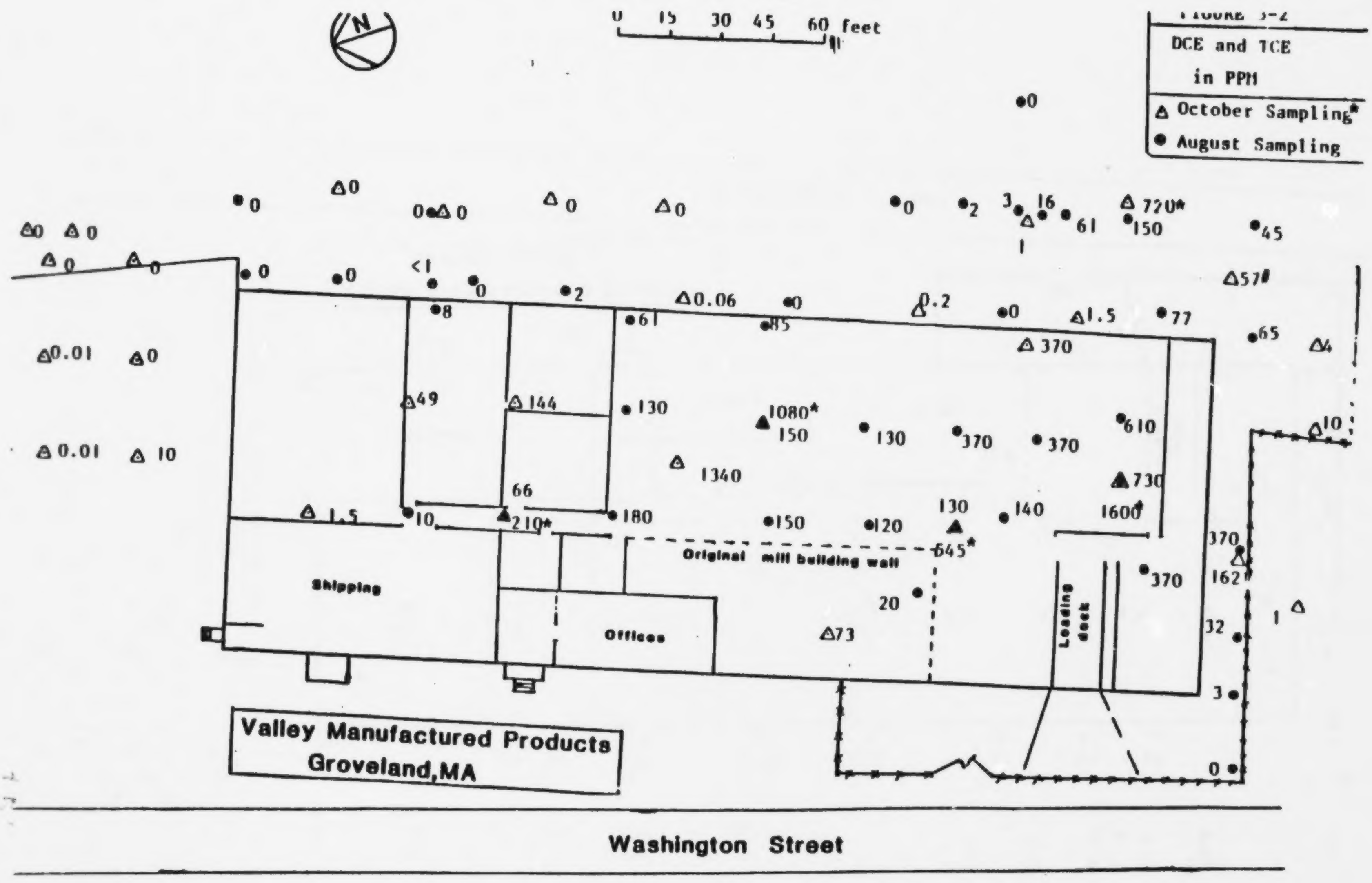
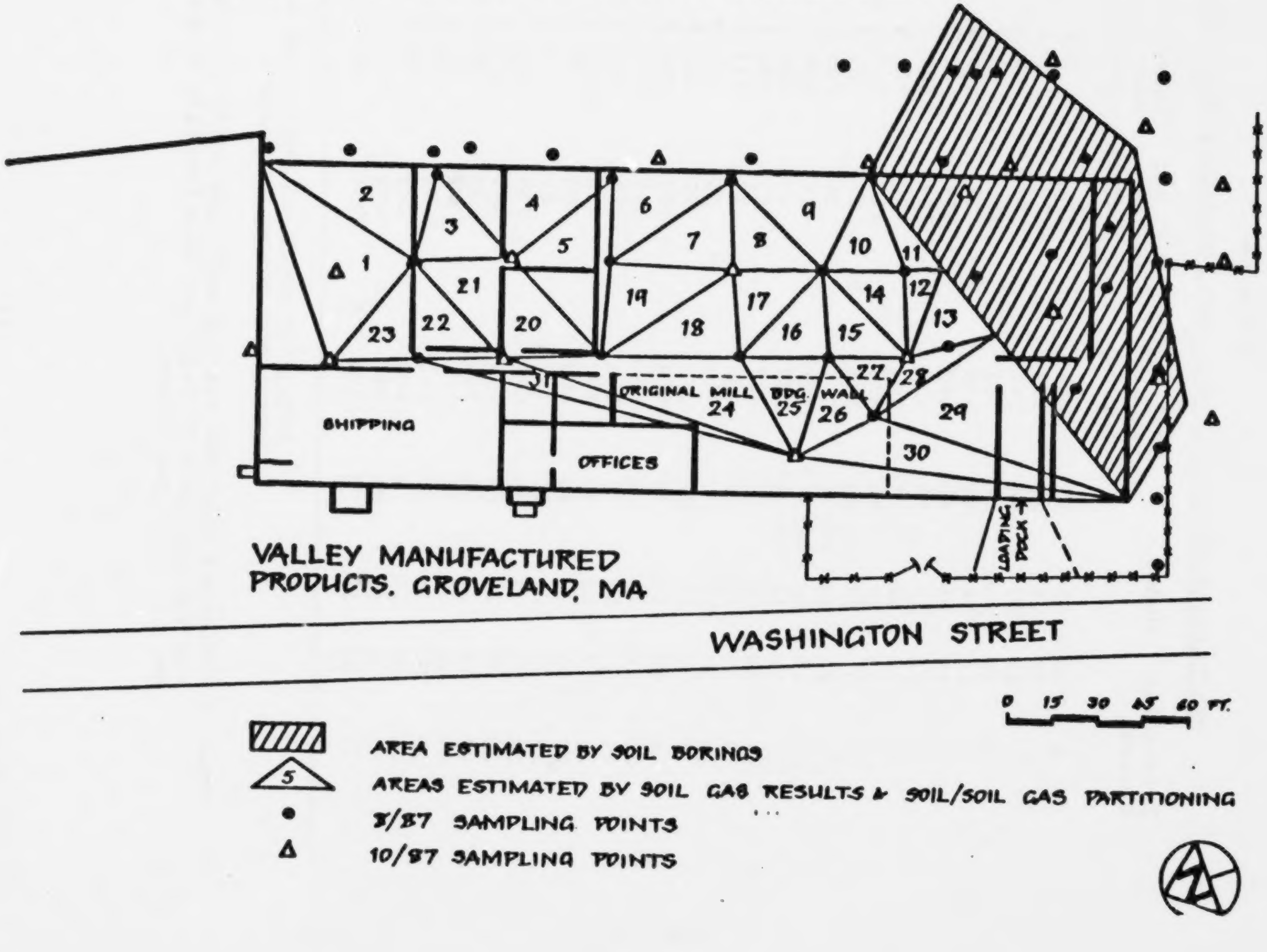


FIGURE 3-2
DCE and TCE
in PPM
△ October Sampling*
● August Sampling
0 15 30 45 60 feet
N
Valley Manufactured Products
Groveland, MA
Washington Street
Shipping
Offices
Original mill building wall
Loading dock
△0 △0 △0 △0
△0.01 △0
△0.01 △10
●0 △0 0●△0 △0 △0
●0 ●0 <1 ●0 ●8 ●2 ●61 △0.06 ●0 ●85 △0.2 ●0 △1.5 ●77
●0 ●2 3 16 ●61 △720* ●150 ●45 △57# ●65 △4 △10
△49 △144 66 ▲210* ●10 △1.5 ●130 ●180
▲1080* 150 △1340 ●130 ●370 ●370 ●610 ▲730 1600# △370
●150 ●120 130 ▲545* ●140 ●20 △73 ●370
370 162# ●32 ●3 ●0 △1

- result from gas bag analysis

FIGURE 3-3 MAP OF TRIANGULAR ELEMENT DISCRETIZATION OF UNSATURATED ZONE BENEATH THE BUILDING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ORIGINAL MILL BDG. WALL
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30
31
SHIPPING
OFFICES
LOADING DOCK
VALLEY MANUFACTURED PRODUCTS, GROVELAND, MA
WASHINGTON STREET
0 15 30 45 60 FT.
AREA ESTIMATED BY SOIL BORINGS
5
AREAS ESTIMATED BY SOIL GAS RESULTS & SOIL/SOIL GAS PARTITIONING
8/87 SAMPLING POINTS
10/87 SAMPLING POINTS

D=29'

TABLE 3-1

CALCULATION OF VOCs IN SOIL GAS FOR EACH ELEMENT AND TOTAL

Triangular Element	Nodes			Soil Volume (cubic meters)	Soil gas volume (cu.meters) @25% g	Geometric mean soil gas-ppm	Cubic meters of TCE vapor
1	36	93	91	1086	271	1.9	0.0005
2	36	22	93	687	172	3.4	0.0006
3	22	93	94	397	99	38.4	0.0038
4	22	24	94	722	180	41.3	0.0074
5	24	94	18	745	186	116.5	0.0217
6	23	24	25	483	121	87.7	0.0106
7	23	25	26	490	122	194.4	0.0238
8	25	26	27	406	102	194.4	0.0197
9	25	27	88	566	142	13.0	0.0018
10	27	28	88	390	97	21.3	0.0021
11	88	28	28/30*	232	58	229.2	0.0133
12	15	28	28/30*	186	46	358.7	0.0166
13	15	29	28/30*	269	67	259.4	0.0175
14	15	28	27	327	82	253.1	0.0207
15	27	16	15	302	75	173.9	0.0131
16	27	16	17	339	85	132.8	0.0112
7	27	17	26	371	93	234.9	0.0218
18	18	17	26	608	152	261.9	0.0398
19	18	23	26	469	117	249.7	0.0292
20	94	18	20	434	108	152.9	0.0166
21	94	20	93	452	113	69.2	0.0078
22	21	20	93	408	102	40.7	0.0042
23	21	91	93	357	89	9.0	0.0008
24	20	17	96	1076	269	114.8	0.0309
25	16	17	96	432	108	109.5	0.0118
26	16	35	96	302	75	56.0	0.0042
27	16	35	15	209	52	93.2	0.0049
28	29	15	35	195	49	98.1	0.0048
29	35	29	3	993	248	20.3	0.0050
30	3	35	96	689	172	16.4	0.0028
31	21	20	96	457	114	46.5	0.0053

TOTAL TCE VAPOR VOLUME (cu.m) = 0.37
TOTAL TCE (VOCs) IN GRAMS = 155

Note: * indicates that the average soil gas concentration of #28 and #30 was used to describe this location where there were no soil gas values.

TABLE 3-2

CALCULATION OF VOCs IN SOIL IN EACH TRIANGULAR ELEMENT AND TOTAL

Triangular Element	Nodes			Soil Vol. in cubic meters	Soil wt. in 1000 kg @ 2000 kg/m^3	Mean soil TCE conc. (mg/kg)	Total TCE kg
1	36	93	91	1086	2172	0.050	0.11
2	36	22	93	687	1373	0.087	0.12
3	22	93	94	397	793	0.984	0.78
4	22	24	94	722	1443	1.058	1.53
5	24	94	18	745	1489	2.987	4.45
6	23	24	25	483	965	2.248	2.17
7	23	25	26	490	979	4.985	4.88
8	25	26	27	406	812	4.985	4.05
9	25	27	88	566	1132	0.334	0.38
10	27	28	88	390	780	0.545	0.43
11	88	28	28/30*	232	464	5.878	2.73
12	15	28	28/30*	186	371	9.196	3.41
13	15	29	28/30*	269	538	6.652	3.58
14	15	28	27	327	654	6.489	4.25
15	27	16	15	302	603	4.458	2.69
16	27	16	17	339	677	3.404	2.31
17	27	17	26	371	742	6.024	4.47
18	18	17	26	608	1216	6.714	8.16
19	18	23	26	469	937	6.401	6.00
20	94	18	20	434	868	3.921	3.40
21	94	20	93	452	905	1.774	1.61
22	21	20	93	408	817	1.045	0.85
23	21	91	93	357	715	0.231	0.17
24	20	17	96	1076	2153	2.942	6.33
25	16	17	96	432	863	2.808	2.42
26	16	35	96	302	603	1.435	0.87
27	16	35	15	209	418	2.389	1.00
28	29	15	35	195	390	2.515	0.98
29	35	29	3	993	1986	0.521	1.04
30	3	35	96	689	1378	0.420	0.58
31	21	20	96	457	914	1.193	1.09

TOTAL VOCs (kg) = 76.8
TOTAL VOCs (gallons) = 13.8

Note: * indicates that the average soil gas concentration of #28 and #30 was used to describe this location where there were no soil gas values

Table 3-3

Experimental Soil/Vapor Partitioning Data and Calculations

Experimental Conditions in 40 ml vial[*]	$\frac{\text{5 ul TCE}}{\text{20 g soil}}$	$\frac{\text{25 ul TCE}}{\text{20 g soil}}$	$\frac{\text{100 ul TCE}}{\text{20 g soil}}$
Headspace Concentrations measured by GC	$\frac{\text{11.5 ng TCE}}{\text{ul air}}$	$\frac{\text{33.5 ng TCE}}{\text{ul air}}$	$\frac{\text{51.3 ng TCE}}{\text{ul air}}$
Headspace concentration in mg/m^3	$11{,}500 \frac{mg}{m^3}$	$33{,}500 \frac{mg}{m^3}$	$51{,}300 \frac{mg}{m^3}$
Headspace concentration in ppm at 20°C	2100 ppm	6140 ppm	9500 ppm
Mass of TCE in soil and headspace at equilibrium (extracted in Methanol and analyzed by GC/Hall)	833 ug	1525 ug	4274 ug
Mass of TCE measured by GC in 32.5 ml headspace	374 ug	1089 ug	1667 ug
Mass of TCE in soil by subtraction	459 ug	436 ug	2607 ug
Soil Concentration ug TCE/20 g soil	$23.0 \frac{ug}{g}$ = ppm	$21.8 \frac{ug}{g}$ = ppm	$130 \frac{ug}{g}$ - ppm
$\frac{\text{Headspace Conc.}}{\text{Soil Conc.}}$ Ratio	91:1	282:1	73:1

---

[*] 20 grams soil per vial - 2.65[1] grams/ml soil density = 7.5 ml soil volume. Therefore air volume in headspace = 32.5 ml.

[1] Buckman and Brady, "The Nature and Properties of Soils", Macmillan, 1969, p. 52.

APPENDIX B

AUGUST 23, 1988 LETTER FROM
MARY K. STINSON, PROJECT MANAGER,
EPA RISK REDUCTION ENGINEERING LABORATORY
TO COUNSEL FOR VALLEY AND GRC

RECEIVED
AUG 29 1988
M.C.P.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RISK REDUCTION ENGINEERING LABORATORY

REPLY TO:
Releases Control Branch
U.S. EPA (MS-104)
Woodbridge Avenue
Edison, New Jersey 08837

August 23, 1988

Mr. Martin C. Pentz
Nutter, McClennen & Fish
One International Place
Boston, MA 02110-2699

RE: Freedom of Information Act Request No. 5277-88

Dear Mr. Pentz:

This is in reference to your letter of July 1, 1988 to John S. Farlow in which you requested documents on the SITE Terra Vac project under the Freedom of Information Act. Your letter has been assigned the EPA Freedom of Information Act request number of 5277-88.

As Steve James and I discussed with you in the respective phone conversations of mid July, we will be glad to provide you with the documents you requested. However, not all of these documents have been prepared to date. Thus, I presently enclose the documents we have, and I will send you the remaining documents by September 20, 1988.

The enclosed documents are:

1. A demonstration plan entitled, "Demonstration Test Plan In-situ Vacuum Extraction Technology Terra Vac, Inc. SITE Program Groveland Wells Superfund SITE, Groveland, MA" dated October 5, 1987.
2. A paper presented at the 14th Annual Research Symposium on Land Disposal, Remedial Action, Incineration and Treatment of Hazardous Waste, May 9-11, 1988, Cincinnati, Ohio entitled "Terra Vac In-situ Vacuum Extraction Process SITE Demonstration."

The documents to be delivered to you by September 20, 1988 are:

1. A draft technical final report from the demonstration of the Terra Vac process under the SITE program. (This document will contain both the presentation and discussion of all pertinent data generated in the course of the Terra Vac project).
2. A paper to be presented on September 21, 1988 at the Haztech International Conference in Cleveland that will discuss the results from the SITE demonstration of the Terra Vac process.

As the EPA Project Manager for the Terra Vac SITE demonstration project, I appreciate your interest in this technology. Thus, if I can be of any further assistance to you please feel free to contact me anytime. My direct phone number is (201) 321-6683.

Sincerely yours,

Mary K. Stinson

Mary K. Stinson
Physical Scientist
Technology Evaluation Section

Enclosure

cc: John S. Farlow
Steven C. James
Robert N. Carr, FOI Coordinator
Jeralene B. Green, A 101
Cynthia A. Holley, RD 674
James S. Ciriello, Region I
Peter A. Michaels, EI

APPENDIX C

ON THE PROSPECT THAT A "POOL" OF TCE EXISTS IN THE UNSATURATED ZONE BENEATH THE VALLEY BUILDING

It has been suggested that there may be a "pool" of free TCE in the unsaturated zone at the Valley Site. The implication is that one must take account of this possibility in calculating the volume of VOCs to be recovered through the vacuum extraction system.

For a "pool" to exist the degree of soil saturation with TCE would be about 90 to 100% (accounting for some retained water in the zone of the pool). The highest TCE concentration detected, however, (2,500 ug/g (ppm) in B-9) represents a degree of saturation of only about 1%, well below that which would be expected if a "pool" existed.

If a "pool" of TCE exists at the Valley Site in the unsaturated zone, it clearly has not been encountered in any exploration to date. The issue, therefore, is whether it is likely that a pool of significant size exists and has, by chance, been missed. It is not.

First, there is reason to believe that the highest concentrations of TCE in the unsaturated zone at the Valley Site have been detected. Boring B-9, in which a TCE concentration of 2,500 ppm was detected at a depth of 10-12', is in the storage shed area of the building downstream of the tank which was reported to have released approximately 500 gallons of TCE. Further, the 10-12' depth corresponds with the top of the clay layer, which is believed to have impeded downward movement of TCE and diverted it easterly across the clay. Yet the degree of TCE saturation of the soil at this point is only about 1%. Since the TCE retention capacity of the soil is 2.5 to 4.0%, TCE at the highest observed concentration is immobile -- an observation inconsistent with the existence of a freely moving "pool."

Furthermore, the existence of the postulated "pool" is contradicted not only by direct observations (as from borings) but by indirect observations as well. Neither the extensive soil gas sampling survey nor the SITE project vacuum extraction work have suggested the presence of a "pool."

Based on the above, it is felt that the probability of the presence of an undetected TCE "pool" of substantial size in the unsaturated zone is infinitessimally small. Any "pool" in the unsaturated zone would likely be quite small and would not contribute greatly to the total volume of TCE.

APPENDIX D

AUGUST 31, 1988 LETTER
FROM JAMES J. MALOT, P.E.,
PRESIDENT, TERRA VAC, INC. TO
COUNSEL FOR VALLEY AND GRC

APPENDIX E

ESTIMATE OF VOLUME OF TCE IN THE SATURATED ZONE

The volume of TCE in the groundwater (both in solution and adsorbed) was estimated by integration of average observed concentrations at wells in the Valley plume as depicted in the ERT RI, figures 5-25 through 5-27 (Volume I). The procedure was as follows:

(a) The sum of TCE and 12TDCE concentrations was averaged for all readings at a particular well. Anomalously low readings were discarded. The resultant averages are shown in Table 1.

(b) Where the edge of the plume was not well defined, assumed points were added based on the overall configuration shown in the above noted figures and on behavior expected by the flowfield. This occurred on the southeast side of the Valley site and immediately east of Mill Pond.

(c) The plume was discretized into triangular elements and the area of each element was calculated. The discretization is shown in Figures 1a through 1e. Assumed points are A-1, A-2, A-3 on the Valley Site and M-3 east of Mill Pond. All assumed points were given as concentration of 100 ppb.

(d) The volume of TCE and 12TDCE within each element was calculated on the basis of a log linear variation using the following parameters:

Saturated thickness: 15' west of Mill Pond, 30' in remainder of aquifer (See line on figure 1: where elements spanned this line, an average was used based on the number of nodes in each zone)

Specific gravity of TCE: 1.46

Porosity: 0.25

Retardation factor: 2.0 (Mason 1984)[1]

(e) The resultant relationship between observed concentrations of nodes (wells) and the mass of TCE and 12TDCE in the elements (including unit conversion) is:

$$M\ (\text{gallons}) = C_{avg}\ (\text{ug/L}) * \text{Area}(\text{ft}^2) * H(\text{ft}) * 2.56\text{x}10^{-9} \left(\frac{\text{L}}{\text{ug}}\right) * \left(\frac{\text{gal}}{\text{ft}^3}\right)$$

The calculations for each element are shown in Table 2. The plume is plotted in Figure 2.

---

[1] Mason, Benjamin J., "Evaluation of Data from the Kingston, NH Site," Engineering Report Submitted to Brown & Nixson Attorneys, April 1984.

The total volume of VOCs (TCE plus 12TDCE) in the groundwater and adsorbed to the soil in the saturated zone was calculated to be 99 gallons.

The mass of VOCs on-site can be calculated in the same manner, by limiting the summation to those elements lying within the area of the Site. This was taken as the area west of B-7, GZ-3, B-14, GZ-2, TW-8A and A-1. The total VOC calculated in this area is 11.5 gallons.

1913c

TABLE I

Average Well Concentrations of TCE, 12TDCE

WELL I.D.	MEASURED CONC (PPB)	X COORD	Y COORD	THICKNESS OF SATURATED ZONE CONTAINING TCE, 12TDCE
B-7	57	106	371	15
TW-22	20	-12	16	15
TW-11A	142	30	44	15
GZ-3	232	155	284	15
TW-12	5395	255	322	15
B-14	6537	164	186	15
TW-15	11400	61	55	15
TW-23	69850	50	29	15
TW-16	3443	35	6	15
TW-19	12550	40	-5	15
A-3	100	37	-27	15
TW-1	13192	52	-6	15
TW-9	80917	60	6	15
TW-18	66900	60	12	15
A-2	100	117	-22	15
TW-17	39225	105	31	15
TW-26A	50000	120	73	15
TW-26	2987	117	85	15
GZ-2	42968	147	101	15
TW-8A	79764	154	54	15
TW-3	3030	114	-1	15
A-1	100	181	5	15
TW-25	53300	244	210	15
TW-24A	2395	277	130	15
ERT-22/7	20	-268	1240	30
ERT-23	48	99	1683	30
DEQE-3	2479	6	1338	30
ERT-16	3	611	1471	30
ERT-9/11/13	553	154	1256	30
DEQE-4	890	226	1133	30
DEQE-1	14706	264	1056	30
DEQE-8	20700	273	583	15
M-3	100	638	710	15
No. 4	20176	299	1071	30
ERT-5/No. 5	36310	287	475	15

TABLE II

```
***  COMPUTATION OF CONTAMINENT MASS  ****

  ELEMENT   AREA   AVG.CONC.   AVG.ELV.   MASS
************************************************************
         1    5281.     415.        15.          0.0941
         2   11318.     123.        15.          0.0536
         3    5803.      55.        15.          0.0121
         4     868.     214.        15.          0.0071
         5     234.  [illegible]    15.          0.0065
         6    5071.    2015.        15.          0.3924
         7    5637.    2586.        15.          0.5597
         8    3033.     721.        15.          0.0840
         9     343.    4836.        15.          0.0637
        10     343.    3244.        15.          0.0427
        11     243.   25245.        15.          0.2351
        12      75.   26514.        15.          0.0764
        13     138.   15176.        15.          0.0801
        14      76.   23750.        15.          0.0693
        15    4348.   12341.        15.          2.0606
        16    3196.   24646.        15.          3.0247
        17    1139.    9432.        15.          0.4125
        18     204.   18583.        15.          0.1456
        19     381.   11941.        15.          0.1747
        20    2123.    6060.        15.          0.4941
        21    1104.   28172.        15.          1.1943
        22     704.   31493.        15.          0.8514
        23     478.   56805.        15.          1.0426
        24     135.   59655.        15.          0.3093
        25     833.   21266.        15.          0.6798
        26     352.   14789.        15.          0.1999
        27    6174.   21674.        15.          5.1386
        28    2661.   56741.        15.          5.7979
        29     733.   55544.        15.          1.5624
        30     857.   53882.        15.          1.7732
        31     888.   21164.        15.          0.7213
       101    4040.    2673.        15.          0.4147
       102    1723.    2891.        15.          0.1912
       103     713.     312.        15.          0.0085
       104     659.    1587.        15.          0.0401
       105     803.     503.        15.          0.0157
       106     134.    2549.        15.          0.0131
       107     604.     293.        15.          0.0068
      1001   42708.     134.        30.          0.4379
      1002  137379.     141.        25.          1.2431
      1003  110643.    1276.        25.          9.0362
      1004    4575.    3189.        30.          1.1207
      1005    6150.    1069.        30.          0.5047
      1006   40450.    2589.        20.          5.3616
      1007   39866.    1653.        15.          1.4152
      1008    2799.   15940.        15.          1.7139
      1009   29343.     404.        30.          0.9098
      1010  103482.      43.        30.          0.3419
      1011   57860.     322.        30.          1.4321
      1012    2259.    2149.        30.          0.3727
      1013    1633.    6416.        30.          0.8044
      1014    2345.   18313.        25.          5.7805
      1015  124116.     182.        25.          1.4476
      1016  103188.    4184.        20.         22.1065

      1017    4820.   24752.        20.          6.1084
      1018   59273.    2056.        15.          4.6834
      1019    4755.    7770.        15.          1.4188
      1020    2289.    9031.        15.          0.7759

*************************************************
TOTAL MASS IN PLUME (GALLONS):     99.06007
*************************************************
```

FIGURE 1-A
Discretization Used to
Calculate Mass of TCE-12TDCE
in Valley Plume

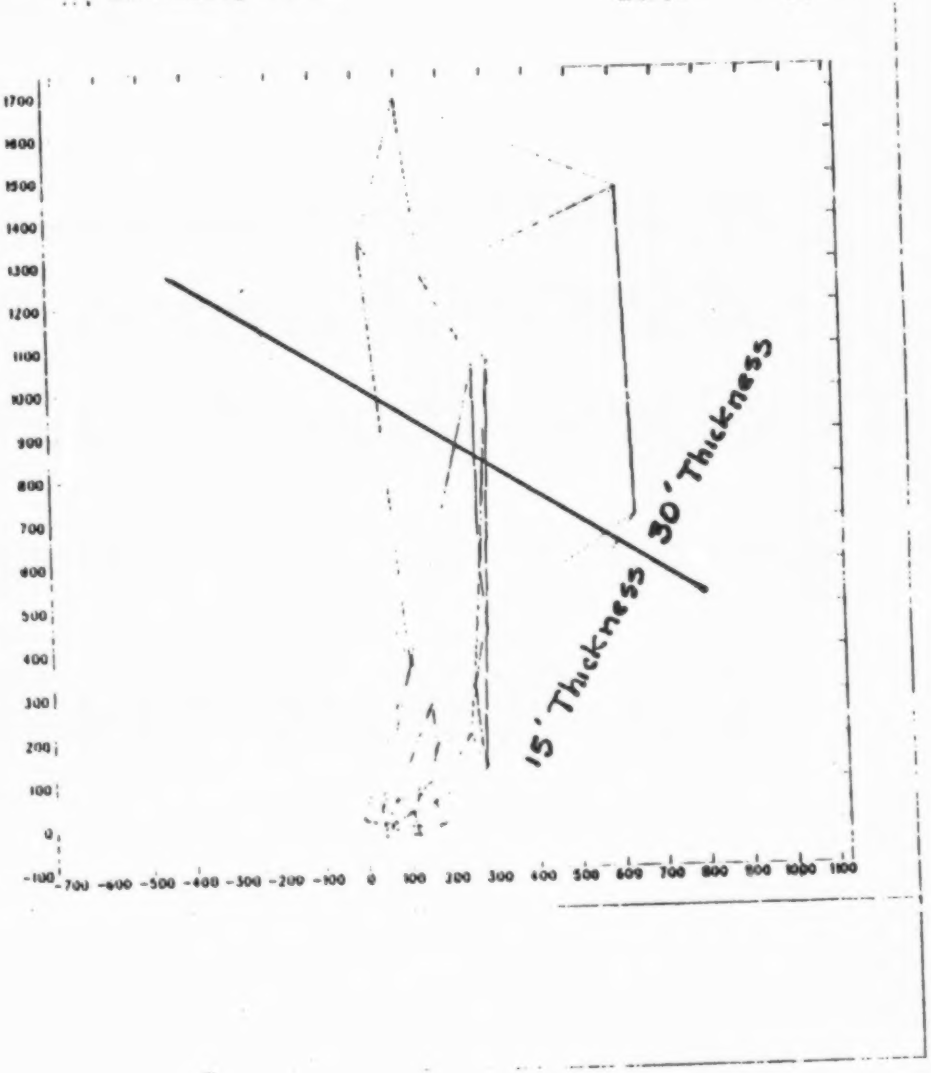

FIGURE 1-B
Enlargement of Southern End of Grid Showing Nodes (red) and Element (blue) Numbers

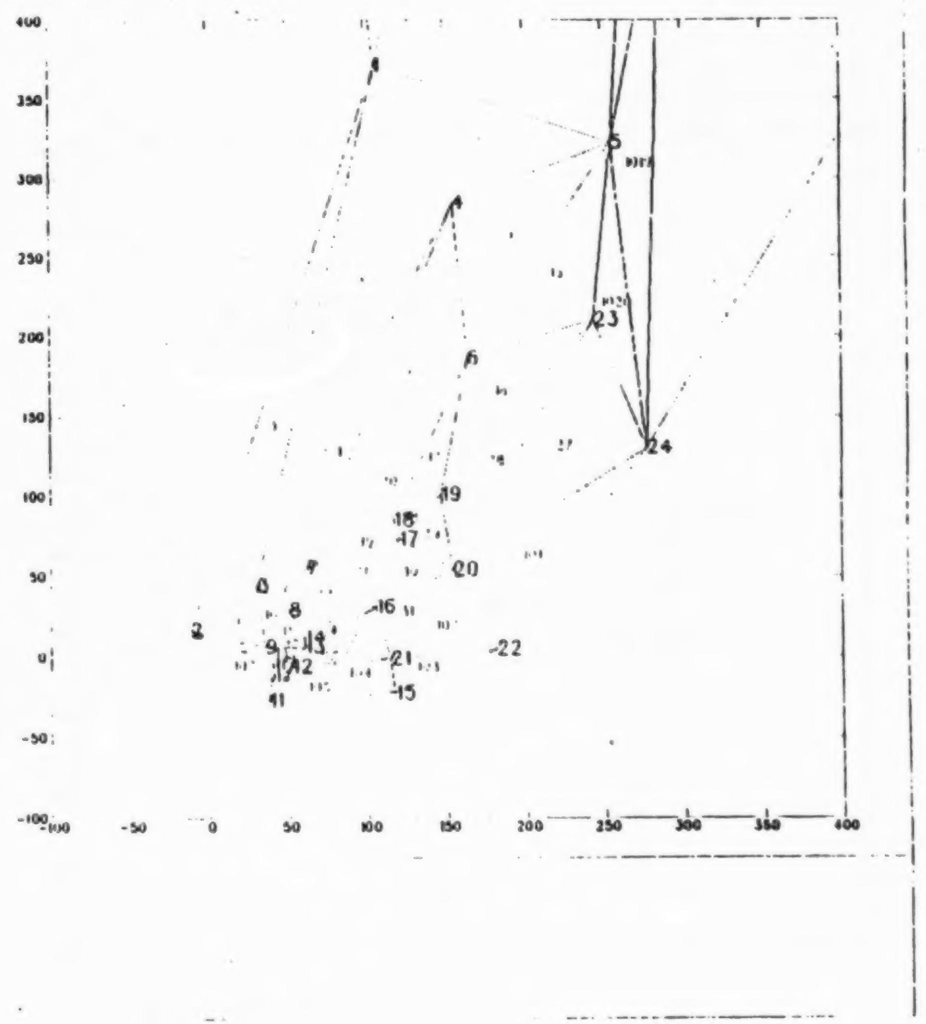
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FIGURE 1-C
Enlargement of Southern
End of Plume Showing
Corresponding
Well Designations

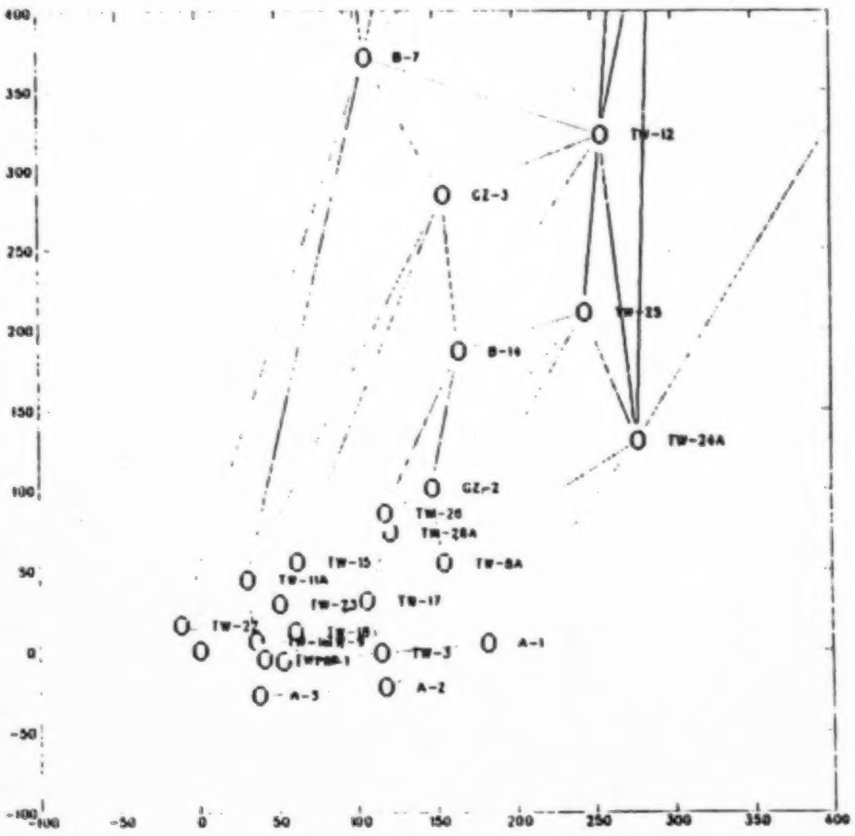
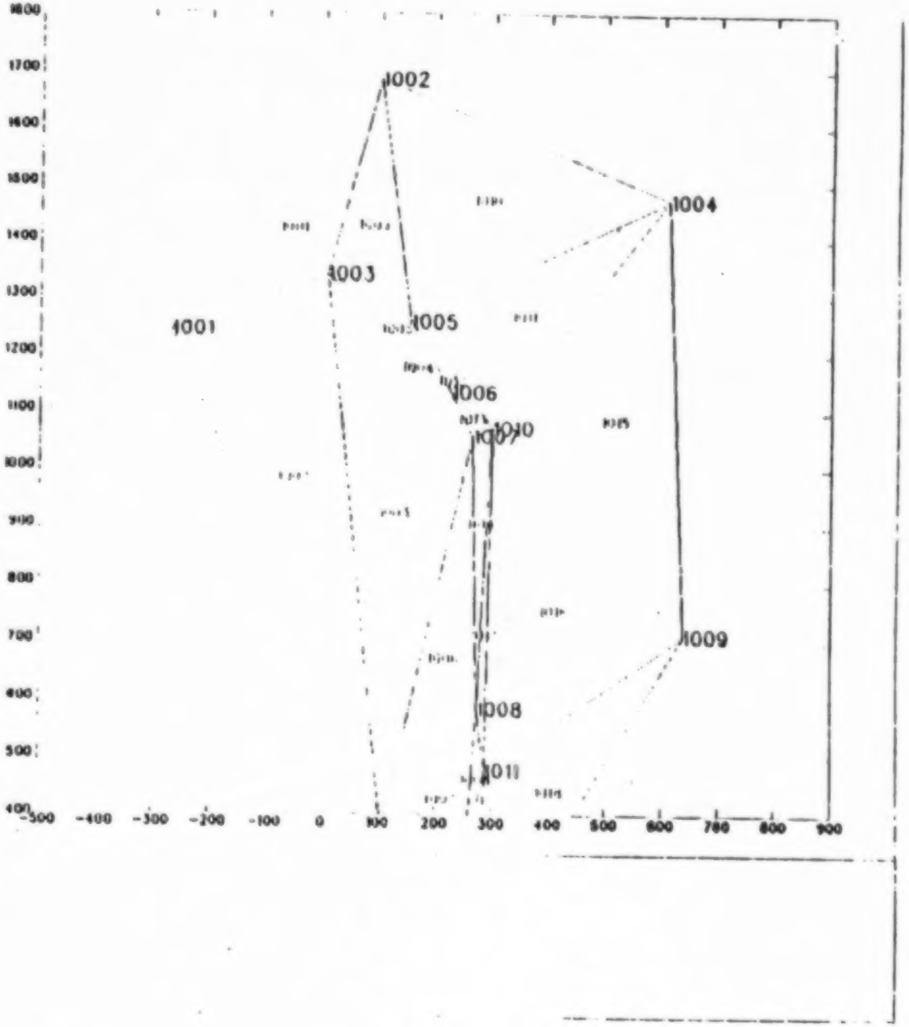


FIGURE 1-D
Enlargement of Northern End of Grid Showing Nodes (red) and Element (blue) Numbers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800
900
1001
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1003
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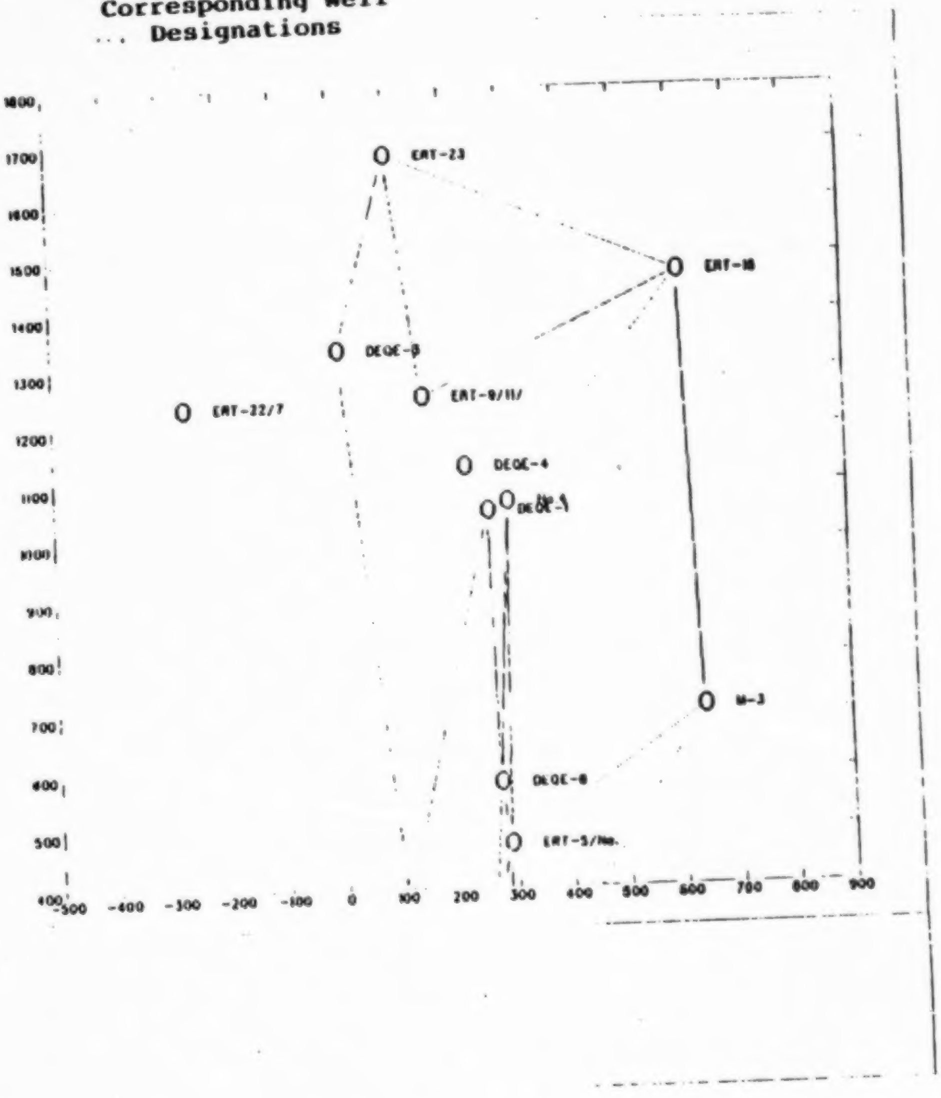
1011

FIGURE
Enlargement Northern
End of Grid Showing
Corresponding Well
... Designations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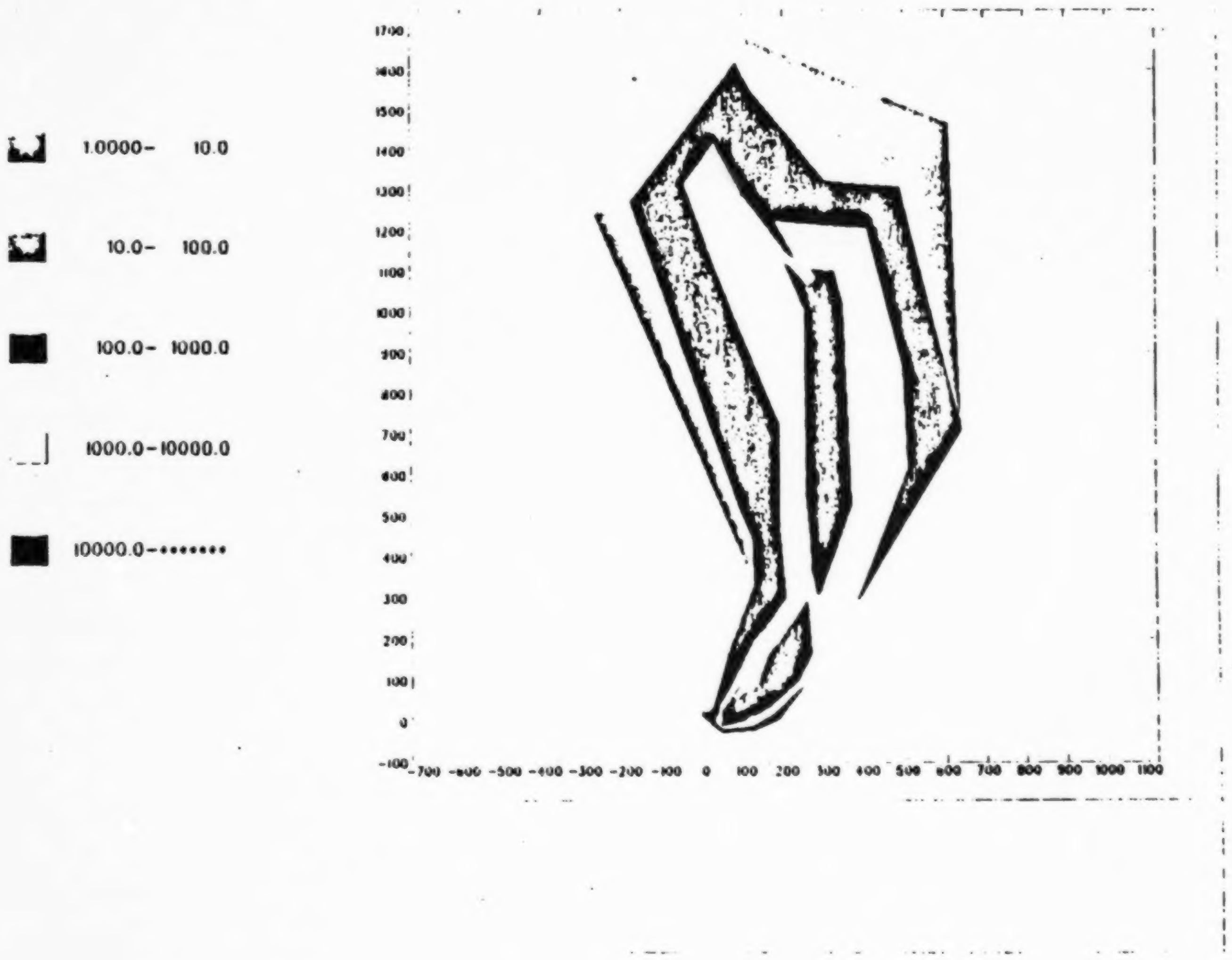
100
200
300
400
500
600
700
800
900
ERT-23
ERT-18
DEQE-8
ERT-9/11/
ERT-22/7
DEQE-4
DEQE-5
W-3
DEQE-6
ERT-5/No.

FIGURE 2
Plot of the Valley Plume
Based on Data
in Table I



APPENDIX F

AUGUST 29, 1988 LETTER FROM JOHN L. FALCONE, JR., M. ANTHONY LALLY ASSOCIATES, TO COUNSEL FOR VALLEY AND GRC

M. Anthony Lally Associates
Consulting Environmental Engineers
M. Anthony Lally, P.E.
100 Belmont Street
North Andover, Massachusetts 01845
Tel. (508) 688-1763

August 29, 1988

RECEIVED
AUG 30 1988
M.C.P.

Attorney Martin C. Pentz
Nutter, McClennen & Fish
One International Place
Boston, MA 02110-2699

Re: Groundwater Treatment Process
Valley Manufactured Products Co., Inc.
Groveland Valley Site
Groveland, MA

Dear Attorney Pentz:

We have reviewed the Draft Feasibility Study (FS) for the Cleanup of Volatile Organic Compounds, Groveland Valley Site, Groveland, MA and have the following comments regarding the High Rate Groundwater Treatment/Reinjection Alternative (GW-3).

A computer simulated model (Figure 1) was developed to determine the removal rate of the volatile organic compounds in the Valley Site groundwater according to the High Rate Groundwater Treatment/Reinjection Alternative which was proposed in the U.S. EPA FS.

The rate of change of groundwater contamination was calculated based on a pore volume of 1.3×10^6 gallons having an average starting concentration of 100 mg/l total volatile organic compounds. The pore volume concentration $(VC)_{(T+1)}$ was calculated as:

$$VC_{(T+1)} = \frac{[V * VC_{(T)}] - [F * FC] + [R * RC]}{V}$$

where: V = pore volume = 1.3×10^6 gallons
$VC_{(T)}$ = VOC concentration in pore volume at $T = 0$ Hrs.
$VC_{(T+1)}$ = VOC concentration in pore volume at $T=T+1$ Hr.
F = Groundwater feed rate to air stripper tower = 30 GPM
FC = VOC concentration in groundwater feed to air stripper tower = $VC_{(T)}$
R = Treated groundwater recycle = F-1.5 GPM = 28.5 GPM
RC = VOC concentration of treated groundwater recycle = (FC x .05)

Table 1., Groundwater Airstrip System, Recirculation Rate = 28.5 GPM, shows the results of the concentration of VOC's in the groundwater and the volumes of VOC which have been removed with vapor phase and liquid phase granulated activated carbon. Figure 2 is a schematic of the groundwater treatment process.

Changing the groundwater feed rate to the air stripper tower from 30 GPM to 15, 5 and 3 GPM in the simulated model produced additional corresponding data found in Tables 2, 3 and 4 respectively. A plot of the data (Figure 3) shows the number of years of operation of the groundwater treatment process required in order to reduce the concentration of VOC's in the groundwater to 1 ppb for the various rates of treated recycle water to be reinjected upgradient in the contamination zone.

The High Rate Groundwater Treatment/Reinjection Process (GW-3) would reduce the total VOC's in the groundwater to approximately 1 ppb in one year. With treated water recycle rates of 3.5 and 1.5 GPM, the length of time to reach 1 ppb would be 6 and 10 years respectively.

It should be noted that previous soil flushing studies have indicated that the limiting rate of reinjection cannot exceed approximately 7 GPM. Reinjection in excess of 7 GPM may cause flooding in the unsaturated zone which would interfere with the soil gas evacuation process.

The estimated costs associated with the 3.0 GPM groundwater treatment process are shown in Table 5 and are compared with the FS estimate for the 30 GPM (GW-3) alternative for groundwater treatment. In comparison, the capital and O & M costs for the 3.0 GPM groundwater treatment process are approximately 20 percent of the proposed FS 30 GPM groundwater treatment process.

A plot of carbon treatment costs vs elapsed time, Figure 4, is attached to this correspondence. Although the total cost of carbon may not vary with the rate of treatment, the rate of carbon adsorption and associated costs are dependent on the rate of treatment.

If groundwater treatment using air stripping in conjunction with groundwater recycle through reinjection is the chosen technology for remedial action at the Valley Site, the reduced rate of treatment at 3.0 GPM is preferred because it has been demonstrated to be:

- Technically feasible
- Within maximum limits for recharge
- Will not interfere with vacuum extraction process
- Lower capital and O & M costs

If you have any questions or require additional information regarding this matter, please do not hesitate to contact this office.

Very truly yours

M. ANTHONY LALLY ASSOCIATES

John L Falcone, Jr.

John L. Falcone, Jr.

JLF/jk
Enclosures

FIGURE 1

```
5  PR# 1
10  PRINT "GROUNDWATER AIRSTRIP S
     YSTEM"
20  PRINT "RECIRCULATION RATE = 1
     .5 GPM"
25  PRINT
30  PRINT "              PPM VOC IN
          VOC V.PH.         VOC L.
     PH"
40  PRINT "              GROUNDWATER
          REMOVED             REMOVE
     D"
45  PRINT
50 T = 0:V = 1300000:VC = 100:F =
     180:R = 90:FC = VC
60 H = 0:D = 0:W = 0:Y = 0:RC = .
     05 * FC
100 T = T + 1:S = S + 1
101 H = T:D = H / 24:W = D / 7:Y =
     W / 52
110 VC = ((V * VC) + (R * RC) - (
     F * FC)) / V
115 FC = VC:RC = .05 * FC
120 VPHVOC = VPVOC + F * FC * .95
      / 1000000
130 LPHVOC = LPVOC + (F * .05 * F
     C * .05 / 1000000)
140  IF S = 168 THEN  PRINT "WEEK
     ";W;"       ";VC;"           ";VP
     HVOC;"       ";LPHVOC
144  IF S = 169 THEN B = B + 1
145  IF S = 168 THEN S = 0
146  IF Y = 10 THEN  END
148  IF B = 50 THEN 160
150  GOTO 100
160  FOR I = 1 TO 16: PRINT : NEXT
     I
165 B = 0: GOTO 100

]
```

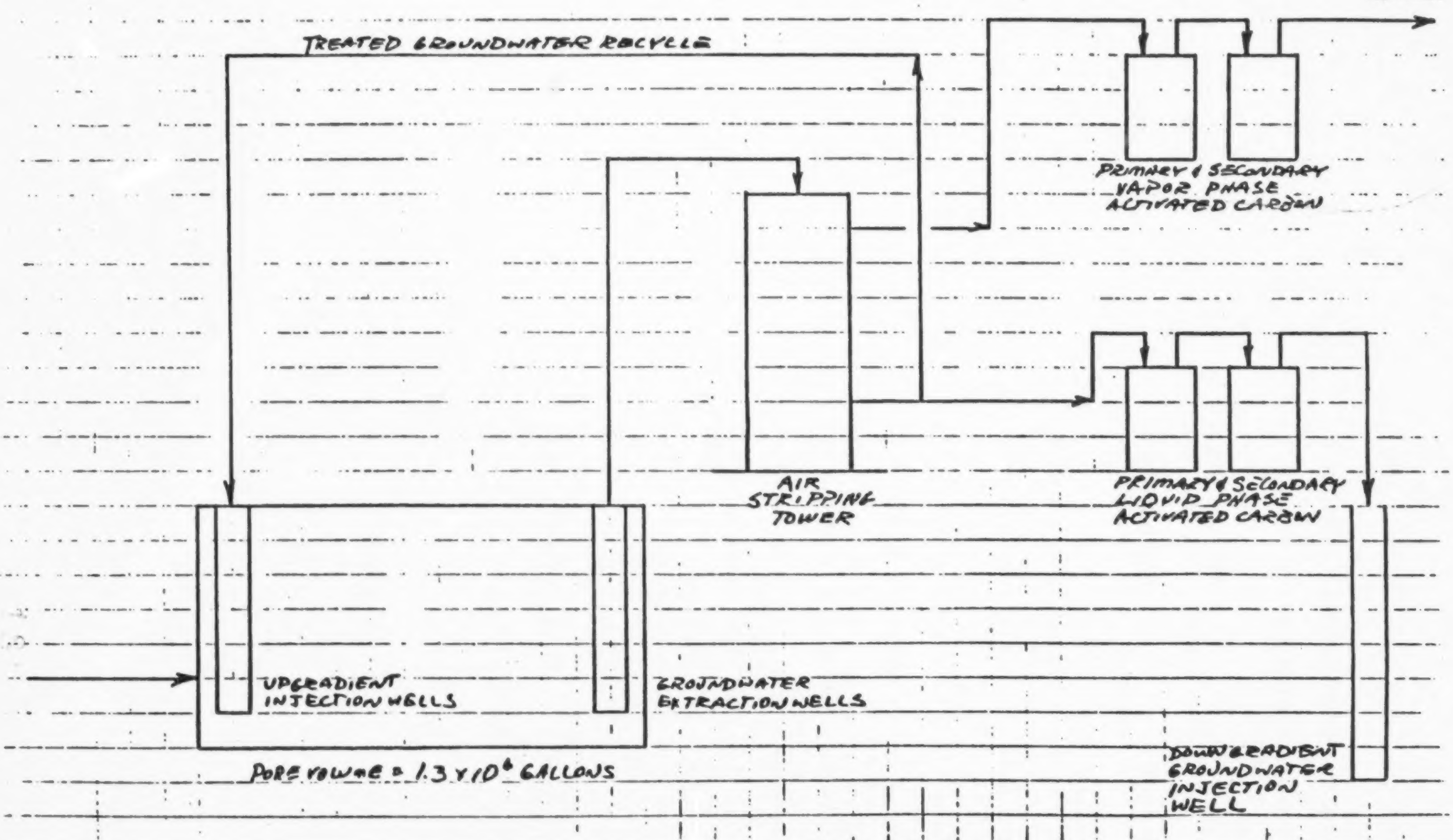

TO ATMOS.
TREATED GROUNDWATER RECYCLE
PRIMARY & SECONDARY VAPOR PHASE ACTIVATED CARBON
AIR STRIPPING TOWER
PRIMARY & SECONDARY LIQUID PHASE ACTIVATED CARBON
UPGRADIENT INJECTION WELLS
GROUNDWATER EXTRACTION WELLS
PORE VOLUME = 1.3 x 10⁶ GALLONS
DOWNGRADIENT GROUNDWATER INJECTION WELL

FIGURE 2.

VALLEY MANUFACTURED PRODUCTS Co. Inc.

PROPOSED GROUNDWATER TREATMENT PROCESS Schematic

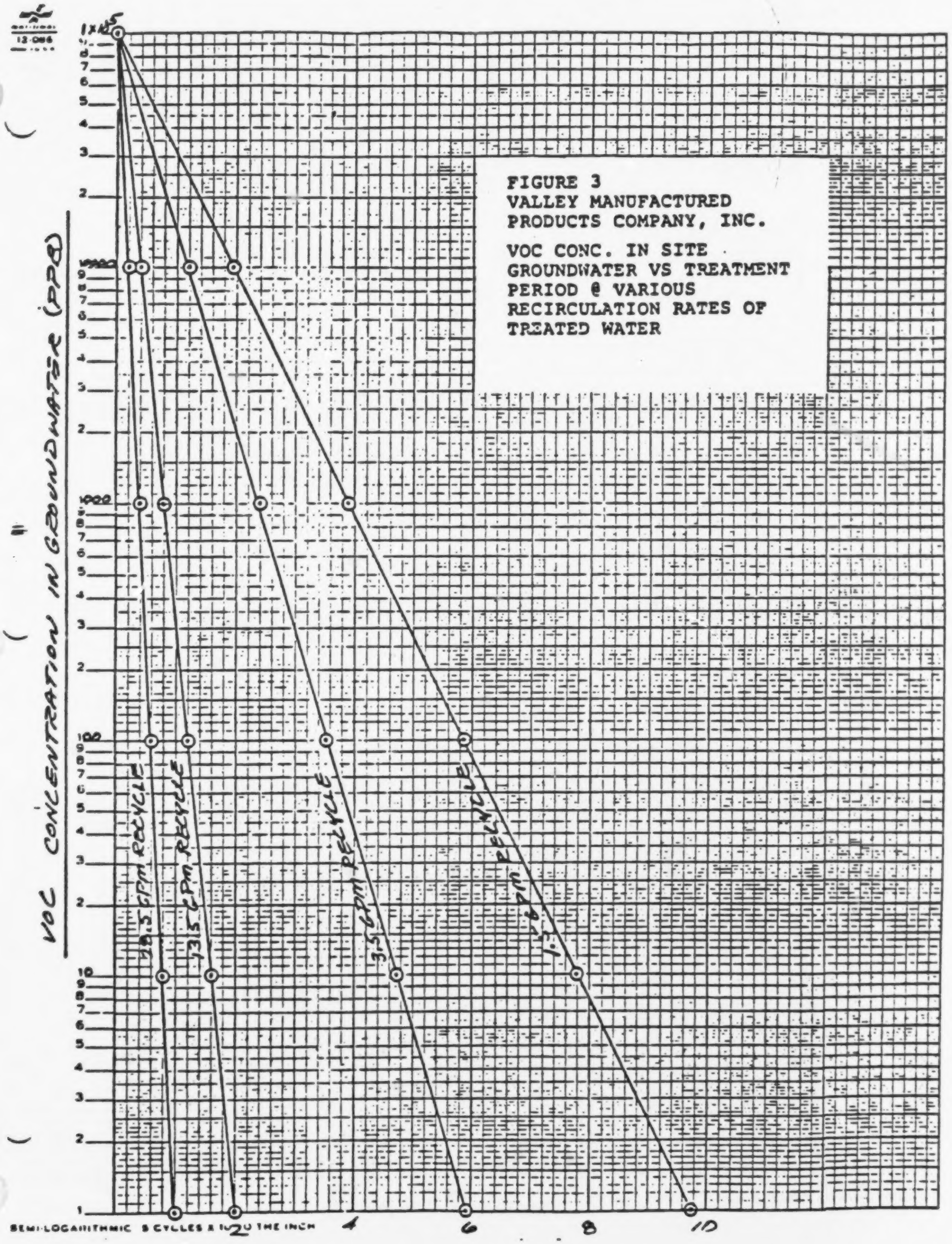


FIGURE 3
VALLEY MANUFACTURED
PRODUCTS COMPANY, INC.

VOC CONC. IN SITE
GROUNDWATER VS TREATMENT
PERIOD @ VARIOUS
RECIRCULATION RATES OF
TREATED WATER

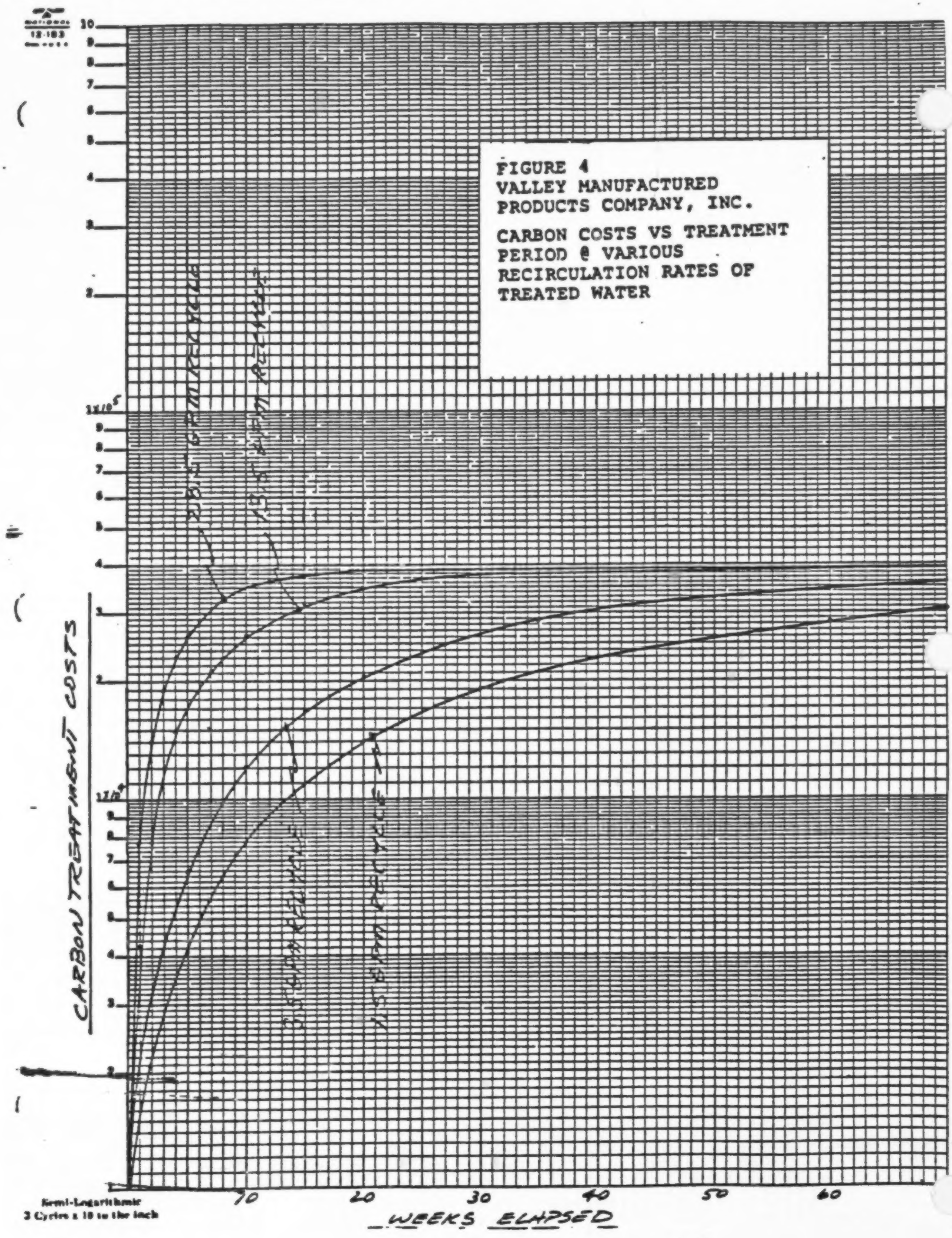


FIGURE 4
VALLEY MANUFACTURED
PRODUCTS COMPANY, INC.

CARBON COSTS VS TREATMENT
PERIOD @ VARIOUS
RECIRCULATION RATES OF
TREATED WATER

TABLE 1

GROUNDWATER AIRSTRIP SYSTEM
RECIRCULATION RATE = 28.5 GPM

	PPM VOC IN GROUNDWATER	VOC V.PH. REMOVED	VOC L.PH REMOVED
WEEK 1	80.1145754	25.7491979	.0677610472
WEEK 2	64.1834515	46.3780586	.122047522
WEEK 3	51.4202993	62.9047825	.165538901
WEEK 4	41.1951543	76.145097	.200381834
WEEK 5	33.0033227	86.7525186	.228296102
WEEK 6	26.4404717	95.2506095	.250659499
WEEK 7	21.1826715	102.058819	.26857584
WEEK 8	16.9704073	107.513187	.282929441
WEEK 9	13.5957696	111.882931	.294428766
WEEK 10	10.8921931	115.383732	.303641402
WEEK 11	8.7262342	118.188384	.311022067
WEEK 12	6.99098542	120.43532	.316935054
WEEK 13	5.60079826	122.235442	.321672219
WEEK 14	4.48705573	123.677603	.325467379
WEEK 15	3.59478562	124.832983	.328507855
WEEK 16	2.87994723	125.758612	.330943719
WEEK 17	2.30725749	126.500175	.332895201
WEEK 18	1.84844953	127.094275	.334458622
WEEK 19	1.48087748	127.570236	.335711151
WEEK 20	1.18639869	127.95155	.336714608
WEEK 21	.95047827	128.257038	.337518525
WEEK 22	.761471626	128.501779	.338162578
WEEK 23	.610049758	128.697852	.33867856
WEEK 24	.488738771	128.854935	.339091935
WEEK 25	.391550989	128.980781	.33942311
WEEK 26	.313689411	129.081603	.339688429
WEEK 27	.251310939	129.162375	.339900989
WEEK 28	.201336691	129.227086	.340071279
WEEK 29	.161300034	129.278928	.340207708
WEEK 30	.129224837	129.320461	.340317007
WEEK 31	.103527929	129.353736	.340404571
WEEK 32	.0829409603	129.380394	.340474722
WEEK 33	.066447798	129.40175	.340530924
WEEK 34	.0532343709	129.41886	.34057595
WEEK 35	.0426484899	129.432567	.340612022
WEEK 36	.0341676563	129.443548	.34064092
WEEK 37	.0273732726	129.452346	.340664073
WEEK 38	.021929981	129.459395	.340682621
WEEK 39	.0175691111	129.465041	.340697482
WEEK 40	.0140754186	129.469565	.340709386
WEEK 41	.0112764618	129.47319	.340718924
WEEK 42	9.03408943E-03	129.476094	.340726565
WEEK 43	7.23762236E-03	129.47842	.340732687
WEEK 44	5.79839039E-03	129.480283	.340737591
WEEK 45	4.64535583E-03	129.481776	.34074152
WEEK 46	3.72160709E-03	129.482972	.340744668
WEEK 47	2.9815497E-03	129.483931	.340747189
WEEK 48	2.38865587E-03	129.484698	.34074921
WEEK 49	1.91366151E-03	129.485313	.340750828
WEEK 50	1.53312178E-03	129.485806	.340752125

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WEEK 51      1.228254E-03        129.486201     .340753164
WEEK 52      9.84010467E-04        129.486517     .340753996
WEEK 53      7.88335806E-04        129.48677     .340754663
WEEK 54      6.3157188E-04       129.486973     .340755197
WEEK 55      5.05981128E-04        129.487136     .340755625
WEEK 56      4.05364631E-04        129.487266     .340755967
WEEK 57      3.24756151E-04        129.487371     .340756242
WEEK 58      2.6017701E-04       129.487454     .340756462
WEEK 59      2.08439705E-04        129.487521     .340756638
WEEK 60      1.66990583E-04        129.487575     .34075678
WEEK 61      1.33783796E-04        129.487618     .340756892
WEEK 62      1.0718032E-04       129.487652     .340756983
WEEK 63      8.58670578E-05        129.487681     .340757056
WEEK 64      6.87920283E-05        129.487701     .340757115
WEEK 65      5.5112441E-05       129.487721     .340757159
WEEK 66      4.41530978E-05        129.487733     .340757199
WEEK 67      3.53730666E-05        129.487743     .340757229
WEEK 68      2.83389818E-05        129.487753     .340757249
WEEK 69      2.27036549E-05        129.487763     .340757268
WEEK 70      1.81889367E-05        129.487773     .340757288
WEEK 71      1.45719893E-05        129.487775     .340757308
WEEK 72      1.16742873E-05        129.487775     .340757318
WEEK 73      9.35280568E-06        129.487775     .340757318
WEEK 74      7.49296057E-06        129.487775     .340757318
WEEK 75      6.0029535E-06       129.487775     .340757318
WEEK 76      4.8092407E-06       129.487775     .340757318
WEEK 77      3.85290274E-06        129.487775     .340757318
WEEK 78      3.08673666E-06        129.487775     .340757318
WEEK 79      2.47292596E-06        129.487775     .340757318
WEEK 80      1.98117413E-06        129.487775     .340757318
WEEK 81      1.58720923E-06        129.487775     .340757318
WEEK 82      1.27158593E-06        129.487775     .340757318
WEEK 83      1.01872566E-06        129.487775     .340757318
WEEK 84      8.16147734E-07        129.487775     .340757318
WEEK 85      6.53853291E-07        129.487775     .340757318
WEEK 86      5.23831785E-07        129.487775     .340757318
WEEK 87      4.19665609E-07        129.487775     .340757318
WEEK 88      3.36213318E-07        129.487775     .340757318
WEEK 89      2.6935587E-07       129.487775     .340757318
WEEK 90      2.15793311E-07        129.487775     .340757318
WEEK 91      1.72881895E-07        129.487775     .340757318
WEEK 92      1.38503595E-07        129.487775     .340757318
WEEK 93      1.10961566E-07        129.487775     .340757318
WEEK 94      8.88963876E-08        129.487775     .340757318
WEEK 95      7.12189632E-08        129.487775     .340757318
WEEK 96      5.70567687E-08        129.487775     .340757318
WEEK 97      4.57107878E-08        129.487775     .340757318
WEEK 98      3.66210035E-08        129.487775     .340757318
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WEEK 102      1.50860788E-08      129.487775      .340757318
WEEK 103      1.20861479E-08      129.487775      .340757318
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WEEK 105      7.75730685E-09      129.487775      .340757318
WEEK 106      6.2147334E-09      129.487775      .340757318
WEEK 107      4.97890723E-09      129.487775      .340757318
WEEK 108      3.98883038E-09      129.487775      .340757318
WEEK 109      3.19563449E-09      129.487775      .340757318
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WEEK 164     1.61693083E-14       129.487775     .340757318
WEEK 165     1.29539726E-14       129.487775     .340757318
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WEEK 217     1.27468449E-19     129.487775     .340757318
WEEK 218     1.02120806E-19     129.487775     .340757318
WEEK 219     8.18136499E-20     129.487775     .340757318
WEEK 220     6.5544658E-20      129.487775     .340757318
WEEK 221     5.2510824E-20      129.487775     .340757318
WEEK 222     4.20688234E-20     129.487775     .340757318
WEEK 223     3.3703259E-20      129.487775     .340757318
WEEK 224     2.70012227E-20     129.487775     .340757318
WEEK 225     2.16319149E-20     129.487775     .340757318
WEEK 226     1.73303167E-20     129.487775     .340757318
WEEK 227     1.38841096E-20     129.487775     .340757318
WEEK 228     1.11231954E-20     129.487775     .340757318
WEEK 229     8.91130071E-21     129.487775     .340757318
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WEEK 231     5.71958033E-21     129.487775     .340757318
WEEK 232     4.58221748E-21     129.487775     .340757318
WEEK 233     3.67102404E-21     129.487775     .340757318
WEEK 234     2.94102531E-21     129.487775     .340757318
WEEK 235     2.35618993E-21     129.487775     .340757318
WEEK 236     1.88765155E-21     129.487775     .340757318
WEEK 237     1.51228401E-21     129.487775     .340757318
WEEK 238     1.21155991E-21     129.487775     .340757318
WEEK 239     9.70636068E-22     129.487775     .340757318
WEEK 240     7.77620962E-22     129.487775     .340757318
WEEK 241     6.22987729E-22     129.487775     .340757318
WEEK 242     4.99103971E-22     129.487775     .340757318
WEEK 243     3.99855024E-22     129.487775     .340757318
WEEK 244     3.20342154E-22     129.487775     .340757318
WEEK 245     2.56640756E-22     129.487775     .340757318
WEEK 246     2.0560665E-22      129.487775     .340757318
WEEK 247     1.64720894E-22     129.487775     .340757318
WEEK 248     1.31965445E-22     129.487775     .340757318
WEEK 249     1.05723555E-22     129.487775     .340757318
WEEK 250     8.46999768E-23     129.487775     .340757318
WEEK 251        6.78570263E-23         129.487775      .340757318
WEEK 252        5.43633683E-23         129.487775      .340757318
WEEK 253        4.35529815E-23         129.487775      .340757318
WEEK 254        3.48922861E-23         129.487775      .340757318
WEEK 255        2.79538066E-23         129.487775      .340757318
WEEK 256        2.23950734E-23         129.487775      .340757318
WEEK 257        1.79417179E-23         129.487775      .340757318
WEEK 258        1.4373931E-23         129.487775      .340757318
WEEK 259        1.15156138E-23         129.487775      .340757318
WEEK 260        9.225685E-24         129.487775      .340757318
WEEK 261        7.39111838E-24         129.487775      .340757318
WEEK 262        5.92136309E-24         129.487775      .340757318
WEEK 263        4.74387488E-24         129.487775      .340757318
WEEK 264        3.80053521E-24         129.487775      .340757318
WEEK 265        3.04478263E-24         129.487775      .340757318
WEEK 266        2.43931467E-24         129.487775      .340757318
WEEK 267        1.95424657E-24         129.487775      .340757318
WEEK 268        1.56563634E-24         129.487775      .340757318
WEEK 269        1.2543029E-24         129.487775      .340757318
WEEK 270        1.00487944E-24         129.487775      .340757318
WEEK 271        8.05054888E-25         129.487775      .340757318
WEEK 272        6.44966301E-25         129.487775      .340757318
WEEK 273        5.16712013E-25         129.487775      .340757318
WEEK 274        4.13961633E-25         129.487775      .340757318
WEEK 275        3.31643602E-25         129.487775      .340757318
WEEK 276        2.65694863E-25         129.487775      .340757318
WEEK 277        2.12860311E-25         129.487775      .340757318
WEEK 278        1.70532134E-25         129.487775      .340757318
WEEK 279        1.36621095E-25         129.487775      .340757318
WEEK 280        1.0945341E-25         129.487775      .340757318
WEEK 281        8.76881343E-26         129.487775      .340757318
WEEK 282        7.02509763E-26         129.487775      .340757318
WEEK 283        5.62812712E-26         129.487775      .340757318
WEEK 284        4.50895011E-26         129.487775      .340757318
WEEK 285        3.61232621E-26         129.487775      .340757318
WEEK 286        2.89399979E-26         129.487775      .340757318
WEEK 287        2.31851563E-26         129.487775      .340757318
WEEK 288        1.85746895E-26         129.487775      .340757318
WEEK 289        1.48810335E-26         129.487775      .340757318
WEEK 290        1.19218768E-26         129.487775      .340757318
WEEK 291        9.55116096E-27         129.487775      .340757318
WEEK 292        7.65187203E-27         129.487775      .340757318
WEEK 293        6.13026478E-27         129.487775      .340757318
WEEK 294        4.91123558E-27         129.487775      .340757318
WEEK 295        3.93461551E-27         129.487775      .340757318
WEEK 296        3.15220051E-27         129.487775      .340757318
WEEK 297        2.52537203E-27         129.487775      .340757318
WEEK 298        2.02319107E-27         129.487775      .340757318
WEEK 299        1.62087092E-27         129.487775      .340757318
WEEK 300        1.29855385E-27         129.487775      .340757318
WEEK 301     1.0403309E-27         129.487775    .340757318
WEEK 302     8.33456677E-28         129.487775    .340757318
WEEK 303     6.67720279E-28         129.487775    .340757318
WEEK 304     5.34941265E-28         129.487775    .340757318
WEEK 305     4.2856592E-28         129.487775    .340757318
WEEK 306     3.43343765E-28         129.487775    .340757318
WEEK 307     2.75068398E-28         129.487775    .340757318
WEEK 308     2.20369878E-28         129.487775    .340757318
WEEK 309     1.76548393E-28         129.487775    .340757318
WEEK 310     1.41440995E-28         129.487775    .340757318
WEEK 311     1.13314853E-28         129.487775    .340757318
WEEK 312     9.07817131E-29         129.487775    .340757318
WEEK 313     7.27293838E-29         129.487775    .340757318
WEEK 314     5.82668365E-29         129.487775    .340757318
WEEK 315     4.66802283E-29         129.487775    .340757318
WEEK 316     3.73976665E-29         129.487775    ,340757318
WEEK 317     2.99609816E-29         129.487775    .340757318
WEEK 318     2.40031131E-29         129.487775    .340757318
WEEK 319     1.92299921E-29         129.487775    .340757318
WEEK 320     1.54060265E-29         129.487775    .340757318
WEEK 321     1.23424727E-29         129.487775    .340757318
WEEK 322     9.88811953E-30         129.487775    .340757318
WEEK 323     7.92182498E-30         129.487775    .340757318
WEEK 324     6.34653643E-30         129.487775    .340757318
WEEK 325     5.08450069E-30         129.487775    .340757318
WEEK 326     4.07342611E-30         129.487775    .340757318
WEEK 327     3.26340801E-30         129.487775    .340757318
WEEK 328     2.61446546E-30         129.487775    .340757318
WEEK 329     2.09456789E-30         129.487775    .340757318
WEEK 330     1.67805417E-30         129.487775    .340757318
WEEK 331     1.34436597E-30         129.487775    .340757318
WEEK 332     1.07703308E-30         129.487775    .340757318
WEEK 333     8.62860473E-31         129.487775    .340757318
WEEK 334     6.91277002E-31         129.487775    .340757318
WEEK 335     5.5381363E-31         129.487775    .340757318
WEEK 336     4.43685438E-31         129.487775    .340757318
WEEK 337     3.55456702E-31         129.487775    .340757318
WEEK 338     2.84772626E-31         129.487775    .340757318
WEEK 339     2.28144379E-31         129.487775    .340757318
WEEK 340     1.827769E-31         129.487775    .340757318
WEEK 341     1.46430937E-31         129.487775    .340757318
WEEK 342     1.17312523E-31         129.487775    .340757318
WEEK 343     9.39844299E-32         129.487775    .340757318
WEEK 344     7.52952266E-32         129.487775    .340757318
WEEK 345     6.03224508E-32         129.487775    .340757318
WEEK 346     4.83270753E-32         129.487775    .340757318
WEEK 347     3.87170309E-32         129.487775    .340757318
WEEK 348     3.10179848E-32         129.487775    .340757318
WEEK 349     2.48499268E-32         129.487775    .340757318
WEEK 350     1.99084132E-32         129.487775    .340757318
WEEK 351      1.59495406E-32         129.487775      .340757318
WEEK 352      1.27779067E-32         129.487775      .340757318
WEEK 353      1.02369657E-32         129.487775      .340757318
WEEK 354      8.20130155E-33         129.487775      .340757318
WEEK 355      6.57043788E-33         129.487775      .340757318
WEEK 356      5.2638784E-33         129.487775      .340757318
WEEK 357      4.21713381E-33         129.487775      .340757318
WEEK 358      3.37853882E-33         129.487775      .340757318
WEEK 359      2.706702E-33         129.487775      .340757318
WEEK 360      2.16846281E-33         129.487775      .340757318
WEEK 361      1.73725476E-33         129.487775      .340757318
WEEK 362      1.39179427E-33         129.487775      .340757318
WEEK 363      1.11503006E-33         129.487775      .340757318
WEEK 364      8.93301599E-34         129.487775      .340757318
WEEK 365      7.1566478E-34         129.487775      .340757318
WEEK 366      5.73351795E-34         129.487775      .340757318
WEEK 367      4.59338354E-34         129.487775      .340757318
WEEK 368      3.67996971E-34         129.487775      .340757318
WEEK 369      2.94819209E-34         129.487775      .340757318
WEEK 370      2.36193156E-34         129.487775      .340757318
WEEK 371      1.89225144E-34         129.487775      .340757318
WEEK 372      1.5159692E-34         129.487775      .340757318
WEEK 373      1.2145122BE-34         129.487775      .340757318
WEEK 374      9.73001354E-35         129.487775      .340757318
WEEK 375      7.79515901E-35         129.487775      .340757318
WEEK 376      6.2450585E-35         129.487775      .340757318
WEEK 377      5.00320206E-35         129.487775      .340757318
WEEK 378      4.00829407E-35         129.487775      .340757318
WEEK 379      3.21122776E-35         129.487775      .340757318
WEEK 380      2.57266148E-35         129.487775      .340757318
WEEK 381      2.06107679E-35         129.487775      .340757318
WEEK 382      1.65122291E-35         129.487775      .340757318
WEEK 383      1.32287022E-35         129.487775      .340757318
WEEK 384      1.05981186E-35         129.487775      .340757318
WEEK 385      8.49063766E-36         129.487775      .340757318
WEEK 386      6.80223829E-36         129.487775      .340757318
WEEK 387      5.44958432E-36         129.487775      .340757318
WEEK 388      4.36591132E-36         129.487775      .340757318
WEEK 389      3.49773129E-36         129.487775      .340757318
WEEK 390      2.80219256E-36         129.487775      .340757318
WEEK 391      2.24496466E-36         129.487775      .340757318
WEEK 392      1.7985439E-36         129.487775      .340757318
WEEK 393      1.44089581E-36         129.487775      .340757318
WEEK 394      1.15436756E-36         129.487775      .340757318
WEEK 395      9.24816664E-37         129.487775      .340757318
WEEK 396      7.40912939E-37         129.487775      .340757318
WEEK 397      5.93579253E-37         129.487775      .340757318
WEEK 398      4.75543497E-37         129.487775      .340757318
WEEK 399      3.80979651E-37         129.487775      .340757318
WEEK 400      3.0522023E-37         129.487775      .340757318
WEEK 401     2.44525889E-37          129.487775       .340757318
WEEK 402     1.95900877E-37          129.487775       .340757318
WEEK 403     1.56945154E-37          129.487775       .340757318
WEEK 404     1.25735943E-37          129.487775       .340757318
WEEK 405     1.00732817E-37          129.487775       .340757318
WEEK 406     8.07016677E-38          129.487775       .340757318
WEEK 407     6.46537981E-38          129.487775       .340757318
WEEK 408     5.14740568E-38          129.487775       .340757318
WEEK 409     4.07844694E-38          129.487775       .340757318
WEEK 410     3.23147823E-38          129.487775       .340757318
WEEK 411     2.56039902E-38          129.487775       .340757318
WEEK 412     2.02868245E-38          129.487775       .340757318
WEEK 413     1.60738715E-38          129.487775       .340757318
WEEK 414     1.27358199E-38          129.487775       .340757318
WEEK 415     1.00909796E-38          129.487775       .340757318
WEEK 416     7.99539171E-39          129.487775       .340757318
WEEK 417     6.33499333E-39          129.487775       .340757318
WEEK 418     5.01940895E-39          129.487775       .340757318
WEEK 419     3.9770312E-39          129.487775       .340757318
WEEK 420     3.15112342E-39          129.487775       .340757318
WEEK 421     0         129.487775      .340757318
WEEK 422     0         129.487775      .340757318
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WEEK 477        0          129.487775        .340757318
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WEEK 518      0        129.487775      .340757318
WEEK 519      0        129.487775      .340757318
WEEK 520      0        129.487775      .340757318
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GROUNDWATER AIRSTRIP SYSTEM
RECIRCULATION RATE = 13.5 GPM

	PPM VOC IN GROUNDWATER	VOC V.PH. REMOVED	VOC L.PH REMOVED
WEEK 1	89.483979	13.5902609	.0357638445
WEEK 2	80.073825	25.7513671	.0677667554
WEEK 3	71.6532447	36.6336089	.0964042334
WEEK 4	64.1181744	46.3714718	.122030188
WEEK 5	57.3754938	55.085299	.144961313
WEEK 6	51.3418747	62.8827783	.165480995
WEEK 7	45.9427524	69.860273	.183842823
WEEK 8	41.1114031	76.1040127	.200273718
WEEK 9	36.7881193	81.6911597	.214976736
WEEK 10	32.9194728	86.6907611	.228133581
WEEK 11	29.4576541	91.1646035	.239906851
WEEK 12	26.3598811	95.1679756	.25044204
WEEK 13	23.5878705	98.7503522	.259869348
WEEK 14	21.1073651	101.956003	.268305277
WEEK 15	18.8877102	104.824551	.275854082
WEEK 16	16.9014747	107.39144	.282609054
WEEK 17	15.1241121	109.688395	.28865367
WEEK 18	13.5336572	111.743801	.294062634
WEEK 19	12.110455	113.58306	.29890279
WEEK 20	10.836917	115.228903	.303233955
WEEK 21	9.69730456	116.701668	.307109652
WEEK 22	8.67753401	118.019557	.310577781
WEEK 23	7.7650027	119.198856	.313681201
WEEK 24	6.9484334	120.254141	.316458265
WEEK 25	6.21773471	121.198451	.318943292
WEEK 26	5.56387645	122.043457	.321166993
WEEK 27	4.97877805	122.799603	.323156849
WEEK 28	4.45520871	123.476232	.324937452
WEEK 29	3.98669801	124.081706	.326530805
WEEK 30	3.56745602	124.623509	.327956602
WEEK 31	3.19230161	125.108336	.329232462
WEEK 32	2.8565985	125.542178	.330374152
WEEK 33	2.556198	125.930397	.33139578
WEEK 34	2.2873877	126.277791	.332309975
WEEK 35	2.04684554	126.588653	.333128033
WEEK 36	1.83159883	126.866825	.333860063
WEEK 37	1.63898752	127.115744	.334515113
WEEK 38	1.46663125	127.338486	.335101278
WEEK 39	1.3124	127.537805	.335625801
WEEK 40	1.17438774	127.716164	.336095166
WEEK 41	1.05088888	127.875766	.336515172
WEEK 42	.94037719	128.018585	.33689101
WEEK 43	.841486929	128.146385	.337227325
WEEK 44	.752995989	128.260745	.337528274
WEEK 45	.673810774	128.363079	.337797574
WEEK 46	.602952691	128.454652	.338038554
WEEK 47	.539546059	128.536595	.338254193
WEEK 48	.482807284	128.60992	.338447155
WEEK 49	.432035169	128.675535	.338619826
WEEK 50	.386602259	128.73425	.338774339

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WEEK 51       .345947084        128.78679      .338912603
WEEK 52       .309567217        128.833806      .339036328
WEEK 53       .277013064        128.875877      .339147041
WEEK 54       .247882311        128.913524      .339246112
WEEK 55       .221814955        128.947212      .339334763
WEEK 56       .198488848        128.977357      .339414093
WEEK 57       .17761572        129.004332      .33948508
WEEK 58       .158937614        129.02847      .339548602
WEEK 59       .142223701        129.05007      .339605445
WEEK 60       .127267427        129.069399      .339656309
WEEK 61       .113883958        129.086695      .339701825
WEEK 62       .101907897        129.102172      .339742554
WEEK 63       .0911912417        129.116021      .339779
WEEK 64       .0816015516        129.128414      .339811614
WEEK 65       .0730203152        129.139504      .339840798
WEEK 66       .0653414837        129.149428      .339866913
WEEK 67       .0584701596        129.158308      .339890281
WEEK 68       .0523214256        129.166255      .339911193
WEEK 69       .0468192936        129.173365      .339929905
WEEK 70       .0418957669        129.179728      .33994665
WEEK 71       .0374899993        129.185422      .339961633
WEEK 72       .0335475432        129.190517      .339975041
WEEK 73       .0300196765        129.195076      .339987039
WEEK 74       .026862801        129.199156      .339997775
WEEK 75       .0240379034        129.202807      .340007382
WEEK 76       .0215100725        129.206073      .340015979
WEEK 77       .0192480687        129.208997      .340023671
WEEK 78       .0172239377        129.211613      .340030555
WEEK 79       .0154126648        129.213953      .340036715
WEEK 80       .0137918658        129.216048      .340042227
WEEK 81       .0123415104        129.217922      .34004716
WEEK 82       .0110436746        129.2196      .340051573
WEEK 83      9.88231947E-03        129.221101      .340055523
WEEK 84      8.84309265E-03        129.222444      .340059057
WEEK 85      7.91315118E-03        129.223646      .34006222
WEEK 86      7.08100253E-03        129.224721      .34006505
WEEK 87      6.33636281E-03        129.225683      .340067583
WEEK 88      5.67002956E-03        129.226545      .340069849
WEEK 89      5.07376808E-03        129.227315      .340071876
WEEK 90      4.54020957E-03        129.228005      .340073691
WEEK 91      4.06276019E-03        129.228622      .340075315
WEEK 92      3.63551947E-03        129.229174      .340076768
WEEK 93      3.25320749E-03        129.229668      .340078068
WEEK 94      2.91109951E-03        129.23011      .340079232
WEEK 95      2.60496768E-03        129.230506      .340080273
WEEK 96      2.33102873E-03        129.23086      .340081205
WEEK 97      2.08589726E-03        129.231176      .340082039
WEEK 98      1.86654387E-03        129.23146      .340082784
WEEK 99      1.67025773E-03        129.231713      .340083452
WEEK 100       1.49461308E-03        129.231941      .340084049
WEEK 101       1.33743926E-03         129.232144      .340084584
WEEK 102       1.19679387E-03         129.232325      .340085062
WEEK 103       1.07093877E-03         129.232488      .34008549
WEEK 104       9.58318626E-04         129.232634      .340085874
WEEK 105       8.57541638E-04         129.232764      .340086217
WEEK 106       7.67362384E-04         129.23288      .340086522
WEEK 107       6.86666394E-04         129.232984      .340086797
WEEK 108       6.14456414E-04         129.233078      .340087042
WEEK 109       5.49840049E-04         129.233161      .340087263
WEEK 110       4.92018756E-04         129.233236      .340087461
WEEK 111       4.40277961E-04         129.233303      .340087637
WEEK 112       3.93978237E-04         129.233363      .340087793
WEEK 113       3.52547405E-04         129.233416      .340087933
WEEK 114       3.15473445E-04         129.233466      .340088058
WEEK 115       2.82298193E-04         129.233506      .340088174
WEEK 116       2.52611657E-04         129.233546      .340088272
WEEK 117       2.26046962E-04         129.23358      .340088365
WEEK 118       2.02275817E-04         129.23361      .340088443
WEEK 119       1.8100445E-04         129.23364      .340088521
WEEK 120       1.61969984E-04         129.233663      .34008858
WEEK 121       1.44937187E-04         129.233683      .340088638
WEEK 122       1.29695562E-04         129.233703      .340088697
WEEK 123       1.1605675E-04         129.233723      .340088737
WEEK 124       1.03852198E-04         129.233743      .340088776
WEEK 125       9.29310793E-05         129.233753      .340088815
WEEK 126       8.31584276E-05         129.233763      .340088854
WEEK 127       7.44134704E-05         129.233773      .340088886
WEEK 128       6.65881345E-05         129.233783      .340088905
WEEK 129       5.95857124E-05         129.233793      .340088925
WEEK 130       5.33196664E-05         129.233803      .340088944
WEEK 131       4.77125591E-05         129.233813      .340088964
WEEK 132       4.26950966E-05         129.233823      .340088983
WEEK 133       3.82052712E-05         129.233833      .340089003
WEEK 134       3.41875969E-05         129.233841      .340089023
WEEK 135       3.05924222E-05         129.233841      .340089042
WEEK 136       2.73753167E-05         129.233841      .340089062
WEEK 137       2.44965226E-05         129.233841      .340089072
WEEK 138       2.19204632E-05         129.233841      .340089072
WEEK 139       1.96153027E-05         129.233841      .340089072
WEEK 140       1.75525534E-05         129.233841      .340089072
WEEK 141       1.57067231E-05         129.233841      .340089072
WEEK 142       1.40550008E-05         129.233841      .340089072
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WEEK 145       1.00708642E-05         129.233841      .340089072
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WEEK 147       8.06412631E-06         129.233841      .340089072
WEEK 148       7.21610111E-06         129.233841      .340089072
WEEK 149       6.45725442E-06         129.233841      .340089072
WEEK 150       5.7782082E-06         129.233841      .340089072
WEEK 151      5.17057062E-06       129.233841      .340089072
WEEK 152      4.62683232E-06       129.233841      .340089072
WEEK 153      4.14027367E-06       129.233841      .340089072
WEEK 154      3.70488163E-06       129.233841      .340089072
WEEK 155      3.31527551E-06       129.233841      .340089072
WEEK 156      2.96664043E-06       129.233841      .340089072
WEEK 157      2.65466791E-06       129.233841      .340089072
WEEK 158      2.37550248E-06       129.233841      .340089072
WEEK 159      2.12569414E-06       129.233841      .340089072
WEEK 160      1.9021557E-06       129.233841      .340089072
WEEK 161      1.70212461E-06       129.233841      .340089072
WEEK 162      1.52312884E-06       129.233841      .340089072
WEEK 163      1.36295629E-06       129.233841      .340089072
WEEK 164      1.21962752E-06       129.233841      .340089072
WEEK 165      1.09137123E-06       129.233841      .340089072
WEEK 166      9.76602406E-07       129.233841      .340089072
WEEK 167      8.73902691E-07       129.233841      .340089072
WEEK 168      7.82002903E-07       129.233841      .340089072
WEEK 169      6.99767312E-07       129.233841      .340089072
WEEK 170      6.26179635E-07       129.233841      .340089072
WEEK 171      5.60330455E-07       129.233841      .340089072
WEEK 172      5.01405986E-07       129.233841      .340089072
WEEK 173      4.48678028E-07       129.233841      .340089072
WEEK 174      4.01494954E-07       129.233841      .340089072
WEEK 175      3.59273661E-07       129.233841      .340089072
WEEK 176      3.21492367E-07       129.233841      .340089072
WEEK 177      2.87684163E-07       129.233841      .340089072
WEEK 178      2.57431237E-07       129.233841      .340089072
WEEK 179      2.30359714E-07       129.233841      .340089072
WEEK 180      2.06135039E-07       129.233841      .340089072
WEEK 181      1.84457835E-07       129.233841      .340089072
WEEK 182      1.65060211E-07       129.233841      .340089072
WEEK 183      1.47702444E-07       129.233841      .340089072
WEEK 184      1.32170024E-07       129.233841      .340089072
WEEK 185      1.18270997E-07       129.233841      .340089072
WEEK 186      1.05833594E-07       129.233841      .340089072
WEEK 187      9.47041117E-08       129.233841      .340089072
WEEK 188      8.47450077E-08       129.233841      .340089072
WEEK 189      7.58332052E-08       129.233841      .340089072
WEEK 190      6.78585696E-08       129.233841      .340089072
WEEK 191      6.07225483E-08       129.233841      .340089072
WEEK 192      5.43369525E-08       129.233841      .340089072
WEEK 193      4.86228673E-08       129.233841      .340089072
WEEK 194      4.35096765E-08       129.233841      .340089072
WEEK 195      3.89341897E-08       129.233841      .340089072
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WEEK 205     1.28169302E-08      129.233841     .340089072
WEEK 206     1.14690991E-08      129.233841     .340089072
WEEK 207     1.02630063E-08      129.233841     .340089072
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WEEK 213     5.26921988E-09      129.233841     .340089072
WEEK 214     4.71510762E-09      129.233841     .340089072
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WEEK 216     3.77556702E-09      129.233841     .340089072
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WEEK 218     3.02324093E-09      129.233841     .340089072
WEEK 219     2.70531629E-09      129.233841     .340089072
WEEK 220     2.42082466E-09      129.233841     .340089072
WEEK 221     2.16625023E-09      129.233841     .340089072
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WEEK 224     1.55218858E-09      129.233841     .340089072
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WEEK 358      5.30655968E-16        129.233841      .340089072
WEEK 359      4.74852076E-16        129.233841      .340089072
WEEK 360      4.24916531E-16        129.233841      .340089072
WEEK 361      3.80232219E-16        129.233841      .340089072
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WEEK 363      3.04466482E-16        129.233841      .340089072
WEEK 364      2.72448722E-16        129.233841      .340089072
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WEEK 367      1.95218351E-16        129.233841      .340089072
WEEK 368      1.74689148E-16        129.233841      .340089072
WEEK 369      1.56318801E-16        129.233841      .340089072
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WEEK 371      1.25170444E-16        129.233841      .340089072
WEEK 372      1.12007494E-16        129.233841      .340089072
WEEK 373      1.00228762E-16        129.233841      .340089072
WEEK 374      8.96886843E-17        129.233841      .340089072
WEEK 375      8.02570033E-17        129.233841      .340089072
WEEK 376      7.18171603E-17        129.233841      .340089072
WEEK 377      6.42648527E-17        129.233841      .340089072
WEEK 378      5.75067476E-17        129.233841      .340089072
WEEK 379      5.14593261E-17        129.233841      .340089072
WEEK 380      4.60478526E-17        129.233841      .340089072
WEEK 381      4.12054506E-17        129.233841      .340089072
WEEK 382      3.6872277E-17        129.233841      .340089072
WEEK 383      3.29947806E-17        129.233841      .340089072
WEEK 384      2.95250425E-17        129.233841      .340089072
WEEK 385      2.64201828E-17        129.233841      .340089072
WEEK 386      2.36418309E-17        129.233841      .340089072
WEEK 387      2.1155651E-17        129.233841      .340089072
WEEK 388      1.89309184E-17        129.233841      .340089072
WEEK 389      1.6940139E-17        129.233841      .340089072
WEEK 390      1.51587104E-17        129.233841      .340089072
WEEK 391      1.35646172E-17        129.233841      .340089072
WEEK 392      1.21381592E-17        129.233841      .340089072
WEEK 393      1.08617079E-17        129.233841      .340089072
WEEK 394      9.71948843E-18        129.233841      .340089072
WEEK 395      8.69738503E-18        129.233841      .340089072
WEEK 396      7.78276621E-18        129.233841      .340089072
WEEK 397      6.96432888E-18        129.233841      .340089072
WEEK 398      6.2319586E-18        129.233841      .340089072
WEEK 399      5.57660455E-18        129.233841      .340089072
WEEK 400      4.99016765E-18        129.233841      .340089072
WEEK 401     4.46540058E-18      129.233841     .340089072
WEEK 402     3.99581811E-18      129.233841     .340089072
WEEK 403     3.57561705E-18      129.233841     .340089072
WEEK 404     3.19960441E-18      129.233841     .340089072
WEEK 405     2.86313335E-18      129.233841     .340089072
WEEK 406     2.56204566E-18      129.233841     .340089072
WEEK 407     2.2926204E-18      129.233841     .340089072
WEEK 408     2.05152797E-18      129.233841     .340089072
WEEK 409     1.83578887E-18      129.233841     .340089072
WEEK 410     1.64273693E-18      129.233841     .340089072
WEEK 411     1.46998637E-18      129.233841     .340089072
WEEK 412     1.3154023E-18      129.233841     .340089072
WEEK 413     1.17707432E-18      129.233841     .340089072
WEEK 414     1.05329294E-18      129.233841     .340089072
WEEK 415     9.42528431E-19      129.233841     .340089072
WEEK 416     8.43411943E-19      129.233841     .340089072
WEEK 417     7.54718565E-19      129.233841     .340089072
WEEK 418     6.75352203E-19      129.233841     .340089072
WEEK 419     6.04332025E-19      129.233841     .340089072
WEEK 420     5.40780343E-19      129.233841     .340089072
WEEK 421     4.8391177E-19      129.233841     .340089072
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WEEK 423     3.87486664E-19      129.233841     .340089072
WEEK 424     3.46738487E-19      129.233841     .340089072
WEEK 425     3.10275395E-19      129.233841     .340089072
WEEK 426     2.7764677E-19      129.233841     .340089072
WEEK 427     2.48449379E-19      129.233841     .340089072
WEEK 428     2.22322391E-19      129.233841     .340089072
WEEK 429     1.98942922E-19      129.233841     .340089072
WEEK 430     1.78022043E-19      129.233841     .340089072
WEEK 431     1.59301208E-19      129.233841     .340089072
WEEK 432     1.4254906E-19      129.233841     .340089072
WEEK 433     1.27558572E-19      129.233841     .340089072
WEEK 434     1.14144486E-19      129.233841     .340089072
WEEK 435     1.02141028E-19      129.233841     .340089072
WEEK 436     9.13998567E-20      129.233841     .340089072
WEEK 437     8.17882285E-20      129.233841     .340089072
WEEK 438     7.31873612E-20      129.233841     .340089072
WEEK 439     6.54909631E-20      129.233841     .340089072
WEEK 440     5.86039199E-20      129.233841     .340089072
WEEK 441     5.24411195E-20      129.233841     .340089072
WEEK 442     4.69264004E-20      129.233841     .340089072
WEEK 443     4.19916104E-20      129.233841     .340089072
WEEK 444     3.75757639E-20      129.233841     .340089072
WEEK 445     3.36242888E-20      129.233841     .340089072
WEEK 446     3.00883515E-20      129.233841     .340089072
WEEK 447     2.69242541E-20      129.233841     .340089072
WEEK 448     2.40928939E-20      129.233841     .340089072
WEEK 449     2.15592803E-20      129.233841     .340089072
WEEK 450     1.92921019E-20      129.233841     .340089072
WEEK 451        1.72633404E-20          129.233841        .340089072
WEEK 452        1.54479239E-20          129.233841        .340089072
WEEK 453        1.3823417E-20          129.233841        .340089072
WEEK 454        1.23697436E-20          129.233841        .340089072
WEEK 455        1.10689388E-20          129.233841        .340089072
WEEK 456        9.90492688E-21          129.233841        .340089072
WEEK 457        8.86332269E-21          129.233841        .340089072
WEEK 458        7.93125383E-21          129.233841        .340089072
WEEK 459        7.09720153E-21          129.233841        .340089072
WEEK 460        6.35085834E-21          129.233841        .340089072
WEEK 461        5.68300076E-21          129.233841        .340089072
WEEK 462        5.08537523E-21          129.233841        .340089072
WEEK 463        4.5505961E-21          129.233841        .340089072
WEEK 464        4.07205447E-21          129.233841        .340089072
WEEK 465        3.64383635E-21          129.233841        .340089072
WEEK 466        3.26064976E-21          129.233841        .340089072
WEEK 467        2.91775915E-21          129.233841        .340089072
WEEK 468        2.610927E-21          129.233841.       .340089072
WEEK 469        2.33636137E-21          129.233841        .340089072
WEEK 470        2.09066913E-21          129.233841        .340089072
WEEK 471        1.87081393E-21          129.233841        .340089072
WEEK 472        1.67407875E-21          129.233841        .340089072
WEEK 473        1.49803228E-21          129.233841        .340089072
WEEK 474        1.34049889E-21          129.233841        .340089072
WEEK 475        1.19953174E-21          129.233841        .340089072
WEEK 476        1.07338873E-21          129.233841        .340089072
WEEK 477        9.60510953E-22          129.233841        .340089072
WEEK 478        8.59503414E-22          129.233841        .340089072
WEEK 479        7.69117856E-22          129.233841        .340089072
WEEK 480        6.88237262E-22          129.233841        .340089072
WEEK 481        6.1586209E-22          129.233841        .340089072
WEEK 482        5.51097905E-22          129.233841        .340089072
WEEK 483        4.93144334E-22          129.233841        .340089072
WEEK 484        4.41285175E-22          129.233841        .340089072
WEEK 485        3.94879535E-22          129.233841        .340089072
WEEK 486        3.5335392E-22          129.233841        .340089072
WEEK 487        3.16195148E-22          129.233841        .340089072
WEEK 488        2.82944E-22          129.233841        .340089072
WEEK 489        2.53189551E-22          129.233841        .340089072
WEEK 490        2.26564085E-22          129.233841        .340089072
WEEK 491        2.02738558E-22          129.233841        .340089072
WEEK 492        1.81418529E-22          129.233841        .340089072
WEEK 493        1.62340519E-22          129.233841        .340089072
WEEK 494        1.45268755E-22          129.233841        .340089072
WEEK 495        1.29992263E-22          129.233841        .340089072
WEEK 496        1.1632225E-22          129.233841        .340089072
WEEK 497        1.04089778E-22          129.233841        .340089072
WEEK 498        9.3143675E-23          129.233841        .340089072
WEEK 499        8.33486662E-23          129.233841        .340089072
WEEK 500        7.45837031E-23          129.233841        .340089072
WEEK 501      6.67404653E-23          129.233841      .340089072
WEEK 502      5.97220241E-23          129.233841      .340089072
WEEK 503      5.34416437E-23          129.233841      .340089072
WEEK 504      4.78217093E-23          129.233841      .340089072
WEEK 505      4.27927682E-23          129.233841      .340089072
WEEK 506      3.82926718E-23          129.233841      .340089072
WEEK 507      3.42658064E-23          129.233841      .340089072
WEEK 508      3.06624071E-23          129.233841      .340089072
WEEK 509      2.7437942E-23          129.233841      .340089072
WEEK 510      2.45525623E-23          129.233841      .340089072
WEEK 511      2.19706098E-23          129.233841      .340089072
WEEK 512      1.96601757E-23          129.233841      .340089072
WEEK 513      1.75927075E-23          129.233841      .340089072
WEEK 514      1.57426547E-23          129.233841      .340089072
WEEK 515      1.40871538E-23          129.233841      .340089072
WEEK 516      1.26057457E-23          129.233841      .340089072
WEEK 517      1.12801229E-23          129.233841      .340089072
WEEK 518      1.00939028E-23          129.233841      .340089072
WEEK 519      9.03242592E-24          129.233841      .340089072
WEEK 520      8.08257411E-24          129.233841      .340089072

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GROUNDWATER AIRSTRIP SYSTEM
RECIRCULATION RATE = 3.5 GPM

	PPM VOC IN GROUNDWATER	VOC V.PH. REMOVED	VOC L.PH REMOVED
WEEK 1	96.3274872	4.69900847	.0123658118
WEEK 2	92.7898478	9.22544524	.0242774875
WEEK 3	89.3821288	13.585648	.0357517054
WEEK 4	86.0995587	17.7857218	.0468045312
WEEK 5	82.9375416	21.8315474	.0574514406
WEEK 6	79.8916498	25.7287895	.0677073409
WEEK 7	76.9576188	29.4829049	.077586592
WEEK 8	74.1313407	33.0991499	.0871030263
WEEK 9	71.4088578	36.5825879	.0962699683
WEEK 10	68.7863583	39.9380961	.105100253
WEEK 11	66.2601707	43.1703729	.113606245
WEEK 12	63.8267576	46.2839439	.121799853
WEEK 13	61.4827119	49.2831686	.12969255
WEEK 14	59.2247515	52.1722465	.137295386
WEEK 15	57.049715	54.9552225	.144619008
WEEK 16	54.954557	57.6359934	.151673668
WEEK 17	52.936344	60.2183127	.158469245
WEEK 18	50.9922501	62.705796	.165015254
WEEK 19	49.1195532	65.1019261	.171320859
WEEK 20	47.3156312	67.4100582	.177394891
WEEK 21	45.5779586	69.6334237	.183245853
WEEK 22	43.9041023	71.775136	.188881938
WEEK 23	42.2917187	73.8381935	.194311036
WEEK 24	40.7385499	75.8254849	.19954075
WEEK 25	39.2424215	77.7397928	.204578403
WEEK 26	37.8012385	79.5837974	.209431047
WEEK 27	36.4129834	81.3600809	.214105477
WEEK 28	35.075712	83.07113	.218608238
WEEK 29	33.787552	84.7193408	.222945635
WEEK 30	32.5466998	86.3070209	.22712374
WEEK 31	31.3514181	87.836393	.231148404
WEEK 32	30.2000333	89.3095989	.235025262
WEEK 33	29.0909332	90.7287009	.238759741
WEEK 34	28.0225649	92.0956862	.242357071
WEEK 35	26.9934327	93.4124692	.245822289
WEEK 36	26.0020955	94.6808927	.249160246
WEEK 37	25.0471653	95.9027334	.252375616
WEEK 38	24.127305	97.0797019	.255472902
WEEK 39	23.2412267	98.213446	.258456439
WEEK 40	22.3876897	99.3055532	.261330405
WEEK 41	21.5654989	100.357553	.264098825
WEEK 42	20.7735033	101.370917	.266765574
WEEK 43	20.0105937	102.347066	.269334387
WEEK 44	19.2757019	103.287365	.271808859
WEEK 45	18.5677994	104.193132	.274192455
WEEK 46	17.8858945	105.065635	.276488514
WEEK 47	17.2290327	105.906095	.278700249
WEEK 48	16.5962942	106.715688	.280830759
WEEK 49	15.9867932	107.49555	.282883026
WEEK 50	15.3996762	108.246771	.284859923

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WEEK 51     14.8341211         108.970403        .286764218
WEEK 52     14.2893362         109.667459        .288598578
WEEK 53     13.7645584         110.338916        .290365571
WEEK 54     13.2590534         110.985714        .29206767
WEEK 55     12.7721129         111.608758        .29370726
WEEK 56     12.3030555         112.208921        .295286636
WEEK 57     11.8512242         112.787043        .296808008
WEEK 58     11.4159865         113.343933        .298273508
WEEK 59     10.9967329         113.880371        .299685187
WEEK 60     10.5928765         114.397108        .301045022
WEEK 61     10.2038518         114.894868        .302354917
WEEK 62     9.82911406         115.374348        .303616706
WEEK 63     9.4681386         115.836219        .304832156
WEEK 64     9.12042004         116.281128        .306002968
WEEK 65     8.78547145         116.709697        .307130783
WEEK 66     8.4628239         117.122527        .308217178
WEEK 67     8.15202559         117.520196        .309263676
WEEK 68     7.85264142         117.90326        .31027174
WEEK 69     7.56425217         118.272257        .311242783
WEEK 70     7.28645404         118.627702        .312178164
WEEK 71     7.01885809         118.970092        .313079193
WEEK 72     6.76108965         119.299909        .313947133
WEEK 73     6.5127878         119.617613        .314783197
WEEK 74     6.27360484         119.923649        .315588556
WEEK 75     6.04320592         120.218447        .316364338
WEEK 76     5.82126842         120.502418        .317111629
WEEK 77     5.60748159         120.775959        .317831476
WEEK 78     5.40154611         121.039455        .318524885
WEEK 79     5.20317363         121.293275        .31919283
WEEK 80     5.0120864         121.537772        .319836245
WEEK 81     4.82801689         121.773291        .320456032
WEEK 82     4.65070734         122.00016        .321053055
WEEK 83     4.47990952         122.218697        .321628153
WEEK 84     4.3153843         122.429208        .32218213
WEEK 85     4.15690126         122.631988        .322715762
WEEK 86     4.00423855         122.827322        .323229796
WEEK 87     3.85718238         123.015481        .323724953
WEEK 88     3.71552687         123.196731        .324201924
WEEK 89     3.57907368         123.371324        .324661379
WEEK 90     3.44763174         123.539505        .325103961
WEEK 91     3.32101704         123.701509        .325530288
WEEK 92     3.19905226         123.857564        .325940959
WEEK 93     3.08156666         124.007888        .326336548
WEEK 94     2.96839574         124.152691        .326717609
WEEK 95     2.85938103         124.292176        .327084675
WEEK 96     2.7543699         124.426538        .327438262
WEEK 97     2.65321531         124.555966        .327778862
WEEK 98     2.55577564         124.680641        .328106954
WEEK 99     2.46191445         124.800737        .328422997
WEEK 100     2.37150033         124.916423        .328727433
WEEK 101     2.28440669      125.02786     .329020688
WEEK 102     2.20051157      125.135205     .329303173
WEEK 103     2.11969751      125.238607     .329575284
WEEK 104     2.04185136      125.338212     .329837402
WEEK 105     1.9668641      125.434159     .330089894
WEEK 106     1.89463077      125.526582     .330333113
WEEK 107     1.82505022      125.615611     .3305674
WEEK 108     1.75802502      125.70137     .330793082
WEEK 109     1.69346132      125.78398     .331010477
WEEK 110     1.63126874      125.863556     .331219886
WEEK 111     1.57136018      125.940209     .331421606
WEEK 112     1.51365178      126.014047     .331615917
WEEK 113     1.45806272      126.085174     .331803092
WEEK 114     1.40451519      126.153688     .331983394
WEEK 115     1.35293418      126.219687     .332157072
WEEK 116     1.3032475      126.283261     .332324373
WEEK 117     1.25538557      126.344501     .33248553
WEEK 118     1.20928138      126.403491     .332640769
WEEK 119     1.16487037      126.460316     .332790306
WEEK 120     1.12209036      126.515053     .332934352
WEEK 121     1.08088145      126.56778     .333073108
WEEK 122     1.04118595      126.618571     .333206767
WEEK 123     1.00294827      126.667496     .333335518
WEEK 124     .966114867      126.714625     .333459541
WEEK 125     .930634175      126.760022     .333579009
WEEK 126     .896456516      126.803753     .33369409
WEEK 127     .863534035      126.845878     .333804944
WEEK 128     .831820634      126.886455     .333911727
WEEK 129     .801271915      126.925542     .334014589
WEEK 130     .771845104      126.963194     .334113672
WEEK 131     .743498993      126.999463     .334209117
WEEK 132     .716193897      127.0344     .334301056
WEEK 133     .689891586      127.068054     .334389618
WEEK 134     .66455523      127.100473     .334474929
WEEK 135     .640149354      127.1317     .334557107
WEEK 136     .616639789      127.161781     .334636266
WEEK 137     .593993616      127.190757     .334712519
WEEK 138     .572179127      127.218668     .334785971
WEEK 139     .551165774      127.245555     .334856725
WEEK 140     .53092414      127.271455     .334924882
WEEK 141     .511425884      127.296403     .334990535
WEEK 142     .492643704      127.320435     .335053777
WEEK 143     .474551301      127.343584     .335114697
WEEK 144     .457123345      127.365883     .335173379
WEEK 145     .440335433      127.387363     .335229906
WEEK 146     .424164058      127.408055     .335284357
WEEK 147     .408586577      127.427986     .335336808
WEEK 148     .393581183      127.447186     .335387333
WEEK 149     .379126864      127.46568     .335436003
WEEK 150     .365203381      127.483495     .335482885
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WEEK 151	.351791241	127.500656	.335528045
WEEK 152	.338871662	127.517187	.335571546
WEEK 153	.326426557	127.533111	.335613451
WEEK 154	.3144385	127.548449	.335653816
WEEK 155	.302890708	127.563225	.335692699
WEEK 156	.291767008	127.577458	.335730154
WEEK 157	.281051826	127.591168	.335766234
WEEK 158	.270730162	127.604375	.335800988
WEEK 159	.260787563	127.617096	.335834466
WEEK 160	.251210105	127.629351	.335866714
WEEK 161	.241984382	127.641155	.335897778
WEEK 162	.233097476	127.652526	.335927701
WEEK 163	.224536942	127.663479	.335956525
WEEK 164	.216290795	127.67403	.335984291
WEEK 165	.208347487	127.684194	.336011037
WEEK 166	.200695899	127.693984	.336036801
WEEK 167	.193325316	127.703415	.336061619
WEEK 168	.18622542	127.712499	.336085525
WEEK 169	.179386267	127.72125	.336108554
WEEK 170	.172798284	127.729679	.336130736
WEEK 171	.166452245	127.737799	.336152104
WEEK 172	.160339264	127.745621	.336172687
WEEK 173	.154450784	127.753155	.336192514
WEEK 174	.148778559	127.760413	.336211613
WEEK 175	.143314648	127.767404	.336230011
WEEK 176	.1380514	127.774138	.336247733
WEEK 177	.132981445	127.780626	.336264804
WEEK 178	.128097684	127.786875	.336281249
WEEK 179	.12339328	127.792894	.336297089
WEEK 180	.118861646	127.798692	.336312347
WEEK 181	.114496437	127.804277	.336327046
WEEK 182	.110291541	127.809657	.336341204
WEEK 183	.10624107	127.81484	.336354843
WEEK 184	.102339353	127.819832	.33636798
WEEK 185	.0985809274	127.824641	.336380636
WEEK 186	.0949605303	127.829274	.336392826
WEEK 187	.0914730932	127.833736	.336404569
WEEK 188	.0881137323	127.838034	.33641588
WEEK 189	.0848777443	127.842174	.336426777
WEEK 190	.0817605982	127.846163	.336437273
WEEK 191	.0787579299	127.850005	.336447383
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WEEK 193	.0730793632	127.85727	.336466504
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WEEK 198	.0606102277	127.873225	.336508489
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WEEK 512     4.78760924E-07          127.95073     .33671239
WEEK 513     4.61178368E-07          127.95073     .33671239
WEEK 514     4.44241534E-07          127.95073     .33671239
WEEK 515     4.27926707E-07          127.95073     .33671239
WEEK 516     4.12211044E-07          127.95073     .33671239
WEEK 517     3.97072542E-07          127.95073     .33671239
WEEK 518     3.82490002E-07          127.95073     .33671239
WEEK 519     3.68443008E-07          127.95073     .33671239
WEEK 520     3.54911892E-07          127.95073     .33671239

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RECIRCULATION RATE = 1.5 GPM

	PPM VOC IN GROUNDWATER	VOC V.PH. REMOVED	VOC L.PH REMOVED
WEEK 1	97.7573761	2.84027344	7.47440378E-03
WEEK 2	95.5650461	5.61685023	.0147811848
WEEK 3	93.4218817	8.33115887	.0219241022
WEEK 4	91.3267801	10.9845958	.0289068308
WEEK 5	89.2786639	13.578526	.0357329633
WEEK 6	87.2764795	16.1142842	.0424060112
WEEK 7	85.3191963	18.5931749	.0489294076
WEEK 8	83.4058074	21.0164734	.0553065088
WEEK 9	81.5353289	23.3854263	.0615405957
WEEK 10	79.7067981	25.7012526	.0676348754
WEEK 11	77.9192744	27.9651436	.0735924833
WEEK 12	76.1718378	30.1782641	.0794164844
WEEK 13	74.4635898	32.3417525	.0851098751
WEEK 14	72.7936517	34.456722	.0906755847
WEEK 15	71.161164	36.5242608	.0961164763
WEEK 16	69.5652868	38.5454324	.101435349
WEEK 17	68.0051989	40.5212767	.106634939
WEEK 18	66.4800983	42.4528103	.111717922
WEEK 19	64.9891995	44.3410269	.116686913
WEEK 20	63.5317362	46.1868979	.121544468
WEEK 21	62.1069584	47.9913729	.126293087
WEEK 22	60.7141329	49.7553804	.130935212
WEEK 23	59.3525432	51.4798278	.135473231
WEEK 24	58.021489	53.1656023	.13990948
WEEK 25	56.720285	54.8135712	.14424624
WEEK 26	55.4482623	56.4245825	.148485743
WEEK 27	54.2047664	57.9994647	.15263017
WEEK 28	52.9891575	59.5390283	.156681653
WEEK 29	51.8008098	61.0440654	.160642277
WEEK 30	50.6391122	62.5153499	.164514079
WEEK 31	49.5034673	63.9536391	.168299051
WEEK 32	48.3932907	65.359673	.17199914
WEEK 33	47.3080113	66.7341748	.17561625
WEEK 34	46.2470706	68.0778519	.179152242
WEEK 35	45.2099228	69.3913951	.182608935
WEEK 36	44.1960342	70.6754806	.185988107
WEEK 37	43.2048834	71.9307687	.189291498
WEEK 38	42.2359603	73.1579055	.192520805
WEEK 39	41.2887666	74.3575222	.195677691
WEEK 40	40.3628149	75.530236	.19876378
WEEK 41	39.4576288	76.6766505	.20178066
WEEK 42	38.5727424	77.7973549	.204729882
WEEK 43	37.7077008	78.8929262	.207612964
WEEK 44	36.8620588	79.963928	.21043139
WEEK 45	36.0353816	81.0109113	.21318661
WEEK 46	35.2272435	82.0344148	.21588004
WEEK 47	34.4372288	83.0349648	.218513066
WEEK 48	33.6649316	84.0130763	.221087043
WEEK 49	32.9099538	84.9692523	.223603297
WEEK 50	32.1719074	85.903985	.22606312

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WEEK 51      31.4504125        86.8177553      .228467778
WEEK 52      30.7450981        87.7110328      .230818508
WEEK 53      30.0556012        88.5842778      .233116521
WEEK 54      29.3815673        89.4379392      .235362998
WEEK 55      28.7226492        90.2724561      .237559095
WEEK 56      28.0785083        91.0882581      .239705942
WEEK 57      27.448813        91.8857645      .241804643
WEEK 58      26.8332393        92.6653859      .243856278
WEEK 59      26.2314706        93.4275231      .245861902
WEEK 60      25.6431972        94.1725685      .247822549
WEEK 61      25.0681168        94.9009053      .249739224
WEEK 62      24.5059331        95.6129082      .251612916
WEEK 63      23.9563572        96.3089437      .253444588
WEEK 64      23.4191063        96.9893697      .255235183
WEEK 65      22.8939038        97.6545363      .256985622
WEEK 66      22.3804796        98.3047857      .258696805
WEEK 67      21.8785696        98.9404526      .260369612
WEEK 68      21.3879156        99.5618638      .262004905
WEEK 69      20.9082651        100.169339      .263603525
WEEK 70      20.4393714        100.763191      .265166293
WEEK 71      19.9809931        101.343725      .266694014
WEEK 72      19.5328946        101.91124      .268187474
WEEK 73      19.0948452        102.466028      .269647441
WEEK 74      18.6666197        103.008373      .271074667
WEEK 75      18.2479976        103.538556      .272469885
WEEK 76      17.8387636        104.05685      .273833813
WEEK 77      17.4387072        104.563519      .275167155
WEEK 78      17.0476226        105.058826      .276470595
WEEK 79      16.6653086        105.543025      .277744804
WEEK 80      16.2915684        106.016366      .278990436
WEEK 81      15.9262098        106.479091      .280208134
WEEK 82      15.5690448        106.931439      .281398523
WEEK 83      15.2198897        107.373642      .282562219
WEEK 84      14.8785648        107.805928      .283699815
WEEK 85      14.5448946        108.22852      .284811898
WEEK 86      14.2187073        108.641635      .285899042
WEEK 87      13.8998352        109.045485      .286961806
WEEK 88      13.5881141        109.440278      .288000736
WEEK 89      13.2833838        109.826218      .289016366
WEEK 90      12.9854875        110.203503      .29000922
WEEK 91      12.6942719        110.572326      .290979807
WEEK 92      12.4095872        110.932878      .291928629
WEEK 93      12.1312868        111.285344      .292856171
WEEK 94      11.8592277        111.629906      .293762913
WEEK 95      11.5932698        111.96674      .29464932
WEEK 96      11.3332764        112.296021      .295515847
WEEK 97      11.0791136        112.617917      .296362942
WEEK 98      10.8306508        112.932594      .29719104
WEEK 99      10.5877601        113.240214      .298000567
WEEK 100      10.3503164        113.540935      .298791938
WEEK 101    10.1181978     113.834912    .299565563
WEEK 102    9.89128463     114.122297    .300321837
WEEK 103    9.66946036     114.403236    .301061152
WEEK 104    9.45261073     114.677875    .301783886
WEEK 105    9.24062427     114.946355    .302490412
WEEK 106    9.03339178     115.208814    .303181094
WEEK 107    8.83080681     115.465387    .303856286
WEEK 108    8.63276502     115.716206    .304516337
WEEK 109    8.43916459     115.961401    .305161584
WEEK 110    8.24990587     116.201096    .305792362
WEEK 111    8.06489138     116.435416    .306408993
WEEK 112    7.88402619     116.664481    .307011795
WEEK 113    7.70721714     116.888409    .307601079
WEEK 114    7.53437323     117.107315    .30817715
WEEK 115    7.3654056     117.321312    .3087403
WEEK 116    7.20022725     117.530509    .30929082
WEEK 117    7.03875324     117.735016    .309828994
WEEK 118    6.88090048     117.934936    .310355098
WEEK 119    6.72658776     118.130372    .310869405
WEEK 120    6.57573571     118.321425    .311372177
WEEK 121    6.42826672     118.508194    .311863674
WEEK 122    6.28410488     118.690775    .312344148
WEEK 123    6.14317603     118.86926    .312813848
WEEK 124    6.00540769     119.043743    .313273013
WEEK 125    5.87072899     119.214313    .313721882
WEEK 126    5.73907062     119.381058    .314160683
WEEK 127    5.61036484     119.544063    .314589644
WEEK 128    5.48454546     119.703413    .315008985
WEEK 129    5.36154773     119.859189    .315418923
WEEK 130    5.24130837     120.011472    .315819666
WEEK 131    5.12376553     120.160339    .316211423
WEEK 132    5.00885875     120.305868    .316594394
WEEK 133    4.89652888     120.448133    .316968776
WEEK 134    4.78671815     120.587208    .317334762
WEEK 135    4.67937006     120.723164    .317692541
WEEK 136    4.5744294     120.856071    .318042296
WEEK 137    4.47184216     120.985997    .318384207
WEEK 138    4.37155554     121.11301    .31871845
WEEK 139    4.27351799     121.237174    .319045199
WEEK 140    4.17767906     121.358554    .319364619
WEEK 141    4.08398942     121.477211    .319676875
WEEK 142    3.9924009     121.593208    .319982129
WEEK 143    3.90286636     121.706603    .320280537
WEEK 144    3.81533975     121.817454    .320572253
WEEK 145    3.72977603     121.92582    .320857426
WEEK 146    3.64613117     122.031736    .321136205
WEEK 147    3.56436216     122.135316    .321408731
WEEK 148    3.48442693     122.236554    .321675146
WEEK 149    3.40628434     122.335521    .321935586
WEEK 150    3.3298942     122.432269    .322190186
WEEK 151      3.2552172       122.526847     .322439075
WEEK 152      3.18221494       122.619304     .322682383
WEEK 153      3.11084984       122.709688     .322920235
WEEK 154      3.04108518       122.798045     .323152752
WEEK 155      2.97288508       122.88442     .323380055
WEEK 156      2.90621445       122.968858     .323602261
WEEK 157      2.84103899       123.051402     .323819483
WEEK 158      2.77732516       123.132096     .324031834
WEEK 159      2.7150402       123.210979     .324239422
WEEK 160      2.65415207       123.288094     .324442356
WEEK 161      2.59462941       123.363479     .324640738
WEEK 162      2.53644163       123.437173     .324834671
WEEK 163      2.47955879       123.509215     .325024255
WEEK 164      2.42395161       123.579641     .325209587
WEEK 165      2.36959149       123.648488     .325390763
WEEK 166      2.31645048       123.715791     .325567876
WEEK 167      2.2645012       123.781585     .325741017
WEEK 168      2.21371696       123.845903     .325910275
WEEK 169      2.16407162       123.908778     .326075737
WEEK 170      2.11553962       123.970244     .326237489
WEEK 171      2.06809602       124.030331     .326395613
WEEK 172      2.02171641       124.089071     .326550191
WEEK 173      1.97637692       124.146493     .326701302
WEEK 174      1.93205422       124.202627     .326849024
WEEK 175      1.88872551       124.257503     .326993432
WEEK 176      1.8463685       124.311148     .327134603
WEEK 177      1.8049614       124.36359     .327272608
WEEK 178      1.76448291       124.414856     .327407518
WEEK 179      1.7249122       124.464972     .327539403
WEEK 180      1.6862289       124.513964     .32766833
WEEK 181      1.64841313       124.561858     .327794365
WEEK 182      1.61144543       124.608677     .327917574
WEEK 183      1.57530677       124.654447     .32803802
WEEK 184      1.53997856       124.69919     .328155765
WEEK 185      1.50544264       124.742929     .328270869
WEEK 186      1.47168122       124.785688     .328383392
WEEK 187      1.43867695       124.827488     .328493392
WEEK 188      1.40641284       124.86835     .328600924
WEEK 189      1.3748723       124.908296     .328706045
WEEK 190      1.34403908       124.947346     .328808808
WEEK 191      1.31389734       124.98552     .328909267
WEEK 192      1.28443156       125.022839     .329007473
WEEK 193      1.25562659       125.05932     .329103478
WEEK 194      1.22746761       125.094984     .329197329
WEEK 195      1.19994014       125.129847     .329289075
WEEK 196      1.17302999       125.163929     .329378763
WEEK 197      1.14672335       125.197246     .32946644
WEEK 198      1.12100665       125.229816     .32955215
WEEK 199      1.09586669       125.261656     .329635939
WEEK 200      1.07129052       125.292781     .329717848
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WEEK 201	1.0472655	125.323209	.329797921
WEEK 202	1.02377927	125.352954	.329876198
WEEK 203	1.00081975	125.382032	.329952719
WEEK 204	.978375128	125.410458	.330027525
WEEK 205	.956433854	125.438247	.330100654
WEEK 206	.934984635	125.465412	.330172142
WEEK 207	.914016445	125.491968	.330242026
WEEK 208	.893518494	125.517929	.330310344
WEEK 209	.873480235	125.543307	.330377129
WEEK 210	.853891359	125.568116	.330442416
WEEK 211	.834741786	125.592369	.330506239
WEEK 212	.816021667	125.616078	.330568631
WEEK 213	.797721366	125.639255	.330629624
WEEK 214	.779831477	125.661913	.330689249
WEEK 215	.762342791	125.684062	.330747537
WEEK 216	.745246311	125.705715	.330804518
WEEK 217	.728533239	125.726882	.33086022
WEEK 218	.712194979	125.747574	.330914674
WEEK 219	.696223127	125.767802	.330967906
WEEK 220	.68060946	125.787577	.331019945
WEEK 221	.665345949	125.806908	.331070816
WEEK 222	.650424727	125.825806	.331120547
WEEK 223	.635838148	125.844279	.331169161
WEEK 224	.621578689	125.862339	.331216687
WEEK 225	.607639016	125.879994	.331263146
WEEK 226	.594011959	125.897252	.331308563
WEEK 227	.580690506	125.914124	.331352962
WEEK 228	.567667802	125.930617	.331396365
WEEK 229	.554937148	125.94674	.331438795
WEEK 230	.542491996	125.962502	.331480273
WEEK 231	.53032594	125.97791	.331520821
WEEK 232	.518432723	125.992973	.33156046
WEEK 233	.506806228	126.007698	.33159921
WEEK 234	.495440471	126.022093	.33163709
WEEK 235	.484329605	126.036164	.331674121
WEEK 236	.473467914	126.049921	.331710323
WEEK 237	.46284981	126.063368	.331745712
WEEK 238	.452469829	126.076515	.331780307
WEEK 239	.442322631	126.089366	.331814126
WEEK 240	.432402997	126.101929	.331847187
WEEK 241	.422705825	126.114211	.331879507
WEEK 242	.413226124	126.126216	.331911101
WEEK 243	.403959016	126.137953	.331941988
WEEK 244	.394899733	126.149427	.331972181
WEEK 245	.386043618	126.160643	.332001697
WEEK 246	.377386111	126.171608	.332030552
WEEK 247	.368922761	126.182327	.332058759
WEEK 248	.360649211	126.192805	.332086334
WEEK 249	.352561206	126.203048	.33211329
WEEK 250	.344654585	126.213062	.332139642

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WEEK 252     .329369312      126.232421     .332190586
WEEK 253     .321982797      126.241776     .332215204
WEEK 254     .314761933      126.250921     .33223927
WEEK 255     .307703007      126.259861     .332262797
WEEK 256     .300802386      126.268601     .332285796
WEEK 257     .29405652      126.277144     .332308279
WEEK 258     .287461938      126.285496     .332330258
WEEK 259     .281015247      126.293661     .332351744
WEEK 260     .274713132      126.301643     .332372748
WEEK 261     .26855235      126.309445     .332393281
WEEK 262     .262529731      126.317073     .332413354
WEEK 263     .256642176      126.32453     .332432976
WEEK 264     .250886657      126.331819     .332452159
WEEK 265     .245260212      126.338945     .332470911
WEEK 266     .239759948      126.345911     .332489243
WEEK 267     .234383034      126.352721     .332507164
WEEK 268     .229126705      126.359378     .332524682
WEEK 269     .223988255      126.365886     .332541808
WEEK 270     .218965041      126.372248     .33255855
WEEK 271     .214054479      126.378467     .332574917
WEEK 272     .209254043      126.384547     .332590916
WEEK 273     .204561261      126.39049     .332606557
WEEK 274     .199973723      126.3963     .332621846
WEEK 275     .195489064      126.40198     .332636793
WEEK 276     .19110498      126.407532     .332651405
WEEK 277     .186819214      126.41296     .332665689
WEEK 278     .182629562      126.418266     .332679653
WEEK 279     .178533868      126.423454     .332693303
WEEK 280     .174530025      126.428524     .332706647
WEEK 281     .170615973      126.433482     .332719692
WEEK 282     .166789699      126.438328     .332732445
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WEEK 284     .159392652      126.447696     .332757098
WEEK 285     .155818074      126.452223     .332769012
WEEK 286     .152323661      126.456649     .332780659
WEEK 287     .148907614      126.460975     .332792044
WEEK 288     .145568176      126.465204     .332803174
WEEK 289     .142303629      126.469339     .332814054
WEEK 290     .139112294      126.473381     .332824691
WEEK 291     .135992529      126.477332     .332835089
WEEK 292     .132942727      126.481194     .332845253
WEEK 293     .129961322      126.48497     .33285519
WEEK 294     .127046778      126.488662     .332864903
WEEK 295     .124197597      126.49227     .332874399
WEEK 296     .121412312      126.495798     .332883683
WEEK 297     .11868949      126.499246     .332892757
WEEK 298     .116027732      126.502617     .332901629
WEEK 299     .113425666      126.505913     .332910301
WEEK 300     .110881955      126.509134     .332918779
WEEK 301      .108395289      126.512284     .332927067
WEEK 302      .105964391      126.515362     .332935169
WEEK 303      .103588008      126.518372     .332943089
WEEK 304      .101264918      126.521314     .332950831
WEEK 305      .0989939275      126.52419     .3329584
WEEK 306      .0967738663     126.527002      .332965799
WEEK 307      .0946035926     126.529751      .332973033
WEEK 308      .0924819899     126.532438      .332980104
WEEK 309      .0904079668     126.535065      .332987017
WEEK 310      .0883804563     126.537632      .332993774
WEEK 311      .0863984152     126.540143      .33300038
WEEK 312      .0844608237     126.542597      .333006838
WEEK 313      .0825666847     126.544996      .33301315
WEEK 314      .0807150244     126.547341      .333019322
WEEK 315      .07890489      126.549633     .333025354
WEEK 316      .0771353502     126.551874      .333031252
WEEK 317      .0754054944     126.554065      .333037018
WEEK 318      .0737144328     126.556207      .333042654
WEEK 319      .0720612955     126.558301      .333048164
WEEK 320      .0704452317     126.560347      .333053549
WEEK 321      .0688654106     126.562348      .333058815
WEEK 322      .0673210188     126.564304      .333063962
WEEK 323      .0658112612     126.566216      .333068994
WEEK 324      .0643353626     126.568085      .333073913
WEEK 325      .062892562     126.569913     .333078721
WEEK 326      .0614821187     126.571699      .333083422
WEEK 327      .0601033061     126.573445      .333088018
WEEK 328      .0587554151     126.575152      .33309251
WEEK 329      .0574377522     126.576821      .333096902
WEEK 330      .0561496395     126.578453      .333101195
WEEK 331      .0548904142     126.580047      .333105391
WEEK 332      .0536594288     126.581606      .333109495
WEEK 333      .0524560495     126.58313      .333113505
WEEK 334      .0512796578     126.58462      .333117426
WEEK 335      .0501296478     126.586077      .333121259
WEEK 336      .0490054282     126.587501      .333125006
WEEK 337      .0479064209     126.588893      .333128668
WEEK 338      .0468320601     126.590253      .333132249
WEEK 339      .045781793     126.591584     .333135749
WEEK 340      .0447550795     126.592884      .333139171
WEEK 341      .0437513915     126.594155      .333142516
WEEK 342      .0427702124     126.595398      .333145787
WEEK 343      .0418110374     126.596612      .333148984
WEEK 344      .0408733731     126.5978      .333152109
WEEK 345      .0399567372     126.598961      .333155164
WEEK 346      .0390606577     126.600096      .33315815
WEEK 347      .0381846741     126.601205      .33316107
WEEK 348      .0373283356     126.60229      .333163924
WEEK 349      .0364912015     126.60335      .333166714
WEEK 350      .0356728411     126.604386      .333169441
WEEK 351      .0348728335       126.6054       .333172108
WEEK 352      .034090767       126.60639       .333174714
WEEK 353      .0333262395       126.607359       .333177263
WEEK 354      .0325788573       126.608305       .333179753
WEEK 355      .031848236       126.60923       .333182188
WEEK 356      .0311339997       126.610135       .333184569
WEEK 357      .0304357812       126.611019       .333186896
WEEK 358      .0297532211       126.611884       .333189171
WEEK 359      .0290859682       126.612729       .333191395
WEEK 360      .0284336793       126.613555       .333193569
WEEK 361      .0277960188       126.614363       .333195695
WEEK 362      .0271726588       126.615152       .333197771
WEEK 363      .0265632783       126.615924       .333199803
WEEK 364      .0259675638       126.616678       .333201788
WEEK 365      .0253852091       126.617416       .333203729
WEEK 366      .0248159142       126.618137       .333205626
WEEK 367      .0242593866       126.618842       .333207481
WEEK 368      .0237153398       126.619531       .333209294
WEEK 369      .0231834939       126.620204       .333211067
WEEK 370      .0226635754       126.620863       .3332128
WEEK 371      .0221553166       126.621506       .333214494
WEEK 372      .0216584562       126.622136       .33321615
WEEK 373      .0211727385       126.622751       .333217768
WEEK 374      .0206979135       126.623352       .333219351
WEEK 375      .0202337372       126.62394      .333220898
WEEK 376      .0197799706       126.624515       .333222411
WEEK 377      .0193363803       126.625077       .333223889
WEEK 378      .018902738       126.625626      .333225334
WEEK 379      .0184788207       126.626163       .333226748
WEEK 380      .0180644102       126.626688       .333228128
WEEK 381      .0176592935       126.627201       .333229478
WEEK 382      .017263262       126.627702      .333230798
WEEK 383      .016876112       126.628193      .333232089
WEEK 384      .0164976443       126.628672       .33323335
WEEK 385      .0161276642       126.629141       .333234583
WEEK 386      .0157659813       126.629599       .333235788
WEEK 387      .0154124097       126.630046       .333236968
WEEK 388      .0150667673       126.630484       .333238119
WEEK 389      .0147288764       126.630912       .333239245
WEEK 390      .0143985631       126.63133      .333240347
WEEK 391      .0140756575       126.631739       .333241423
WEEK 392      .0137599934       126.632139       .333242474
WEEK 393      .0134514084       126.63253      .333243502
WEEK 394      .013149744       126.632912      .333244508
WEEK 395      .0128548446       126.633285       .333245491
WEEK 396      .0125665588       126.633651       .333246453
WEEK 397      .0122847381       126.634008       .333247393
WEEK 398      .0120092376       126.634356       .33324831
WEEK 399      .0117399156       126.634698       .333249208
WEEK 400      .0114766334       126.635031       .333250085
WEEK 401     .0112192557        126.635357    .333250943
WEEK 402     .0109676499        126.635676    .333251782
WEEK 403     .0107216868        126.635987    .333252602
WEEK 404     .0104812397        126.636292    .333253404
WEEK 405     .0102461849        126.636589    .333254186
WEEK 406     .0100164016        126.636881    .333254951
WEEK 407     9.79177138E-03        126.637165    .333255699
WEEK 408     9.57217875E-03        126.637443    .333256431
WEEK 409     9.35751076E-03        126.637715    .333257147
WEEK 410     9.14765697E-03        126.637981    .333257847
WEEK 411     8.94250941E-03        126.63824    .333258532
WEEK 412     8.74196256E-03        126.638494    .333259198
WEEK 413     8.5459132E-03        126.638743    .333259851
WEEK 414     8.35426051E-03        126.638985    .333260491
WEEK 415     8.16690588E-03        126.639223    .333261117
WEEK 416     7.98375288E-03        126.639455    .333261725
WEEK 417     7.80470732E-03        126.639681    .333262322
WEEK 418     7.62967709E-03        126.639903    .333262908
WEEK 419     7.45857213E-03        126.64012    .333263475
WEEK 420     7.29130441E-03        126.640332    .333264033
WEEK 421     7.12778787E-03        126.640539    .333264581
WEEK 422     6.96793837E-03        126.640741    .33326511
WEEK 423     6.81167373E-03        126.640939    .333265633
WEEK 424     6.6589135E-03        126.641133    .333266141
WEEK 425     6.50957912E-03        126.641322    .333266638
WEEK 426     6.36359373E-03        126.641507    .333267127
WEEK 427     6.22088224E-03        126.641687    .3332676
WEEK 428     6.08137124E-03        126.641864    .333268069
WEEK 429     5.94498896E-03        126.642037    .333268519
WEEK 430     5.81166523E-03        126.642206    .333268968
WEEK 431     5.6813314E-03        126.642371    .333269398
WEEK 432     5.55392053E-03        126.642532    .333269827
WEEK 433     5.42936698E-03        126.64269    .333270238
WEEK 434     5.3076067E-03        126.642845    .333270648
WEEK 435     5.18857705E-03        126.642995    .33327104
WEEK 436     5.07221679E-03        126.643142    .333271431
WEEK 437     4.95846605E-03        126.643287    .333271808
WEEK 438     4.8472663E-03        126.643427    .333272179
WEEK 439     4.73856033E-03        126.643565    .333272542
WEEK 440     4.63229224E-03        126.6437    .333272894
WEEK 441     4.52840736E-03        126.643831    .333273246
WEEK 442     4.42685221E-03        126.64396    .333273579
WEEK 443     4.32757456E-03        126.644085    .333273911
WEEK 444     4.23052333E-03        126.644208    .333274236
WEEK 445     4.13564861E-03        126.644328    .333274549
WEEK 446     4.04290158E-03        126.644446    .333274862
WEEK 447     3.95223449E-03        126.644561    .333275162
WEEK 448     3.86360075E-03        126.644673    .333275456
WEEK 449     3.77695472E-03        126.644783    .333275749
WEEK 450     3.69225184E-03        126.64489    .333276029
WEEK 451        3.60944853E-03          126.644995      .333276302
WEEK 452        3.52850217E-03          126.645097      .333276576
WEEK 453        3.44937115E-03          126.645197      .333276839
WEEK 454        3.37201473E-03          126.645296      .333277094
WEEK 455        3.29639313E-03          126.645391      .333277348
WEEK 456        3.22246743E-03          126.645486      .333277599
WEEK 457        3.15019959E-03          126.645576      .333277834
WEEK 458        3.07955245E-03          126.645666      .333278068
WEEK 459        3.01048967E-03          126.645753      .333278303
WEEK 460        2.94297571E-03          126.645838      .333278528
WEEK 461        2.87697585E-03          126.645924      .333278744
WEEK 462        2.81245609E-03          126.646004      .333278959
WEEK 463        2.74938329E-03          126.646084      .333279174
WEEK 464        2.68772496E-03          126.646163      .33327938
WEEK 465        2.62744941E-03          126.646238      .333279575
WEEK 466        2.56852559E-03          126.646313      .333279771
WEEK 467        2.51092323E-03          126.646387      .333279966
WEEK 468        2.45461266E-03          126.646457      .333280161
WEEK 469        2.39956493E-03          126.646527      .333280337
WEEK 470        2.34575172E-03          126.646596      .333280513
WEEK 471        2.29314532E-03          126.646661      .333280689
WEEK 472        2.2417187E-03          126.646726      .333280865
WEEK 473        2.19144539E-03          126.646792      .333281038
WEEK 474        2.14229951E-03          126.646853      .333281194
WEEK 475        2.09425579E-03          126.646913      .333281351
WEEK 476        2.04728951E-03          126.646973      .333281507
WEEK 477        2.00137652E-03          126.647033      .333281664
WEEK 478        1.95649317E-03          126.647088      .33328182
WEEK 479        1.91261639E-03          126.647143      .333281964
WEEK 480        1.86972359E-03          126.647198      .333282101
WEEK 481        1.82779273E-03          126.647253      .333282238
WEEK 482        1.78680221E-03          126.647303      .333282375
WEEK 483        1.74673096E-03          126.647353      .333282512
WEEK 484        1.70755835E-03          126.647403      .333282649
WEEK 485        1.66926424E-03          126.647453      .333282779
WEEK 486        1.63182893E-03          126.6475       .333282897
WEEK 487        1.59523314E-03          126.647545      .333283014
WEEK 488        1.55945807E-03          126.64759      .333283131
WEEK 489        1.52448529E-03          126.647635      .333283249
WEEK 490        1.49029682E-03          126.64768      .333283366
WEEK 491        1.45687507E-03          126.647722      .333283483
WEEK 492        1.42420284E-03          126.647762      .333283601
WEEK 493        1.39226333E-03          126.647802      .333283699
WEEK 494        1.3610401E-03          126.647842      .333283797
WEEK 495        1.33051709E-03          126.647882      .333283895
WEEK 496        1.3006786E-03          126.647921      .333283993
WEEK 497        1.27150927E-03          126.647956      .333284091
WEEK 498        1.2429941E-03          126.647991      .333284188
WEEK 499        1.21511841E-03          126.648026      .333284286
WEEK 500        1.18786788E-03          126.648061      .333284384
WEEK 501      1.16122847E-03         126.648096      .333284479
WEEK 502      1.13518648E-03         126.648131      .333284558
WEEK 503      1.10972852E-03         126.648162      .333284636
WEEK 504      1.08484148E-03         126.648192      .333284714
WEEK 505      1.06051257E-03         126.648222      .333284792
WEEK 506      1.03672926E-03         126.648252      .333284871
WEEK 507      1.01347932E-03         126.648282      .333284949
WEEK 508      9.90750793E-04         126.648312      .333285027
WEEK 509      9.68531981E-04         126.648342      .333285105
WEEK 510      9.4681145E-04         126.648369      .333285184
WEEK 511      9.25578031E-04         126.648394      .333285262
WEEK 512      9.04820795E-04         126.648419      .333285339
WEEK 513      8.84529069E-04         126.648444      .333285398
WEEK 514      8.6469241E-04         126.648469      .333285457
WEEK 515      8.45300613E-04         126.648494      .333285515
WEEK 516      8.263437E-04         126.648519      .333285574
WEEK 517      8.07811921E-04         126.648544      .333285633
WEEK 518      7.89695743E-04         126.648569      .333285691
WEEK 519      7.71985839E-04         126.648591      .33328575
WEEK 520      7.54673098E-04         126.648611      .333285809

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TABLE 5

VALLEY MANUFACTURED PRODUCTS COMPANY, INC.
GROUNDWATER TREATMENT COST COMPARISON
EPA FS VS. PROPOSED TREATMENT PLAN

	(EPA GW-3) 30 GPM (FS)	(PROPOSED) 3 GPM
Mobilization	10,000	3,000
Site Preparation		
Concrete Pad	5,000	---
Equipment & Supplies		
Air Stripping Tower	35,000	7,000
Storage Tanks	10,000	1,000
Carbon Canisters	8,000	10,800
Building	40,000	17,000
Analytical Equipment	20,000	500
Equipment Installation	18,550	5,000
Services Cost	164,438	20,000
Instrumentation	---	1,200
Piping	---	10,500
Electrical	---	8,300
Groundwater Monitoring		
Sampling	8,400	6,240
Equipment	1,200	---
Shipping	1,067	---
Analysis	16,000	4,420
Validation	7,200	---
Groundwater Treatment O & M		
Labor	52,000	6,240
Chemicals		
H_2SO_4	220	---
Carbon	20,000	25,000
Maintenance	23,566	10,000
Power	1,600	1,600
Sample & Analysis	8,256	4,420
Groundwater Recovery System		
Recovery Wells	98,000	20,000
Reinjection Wells	70,000	---
Replace Reinjection Wells	12,668	---

VALLEY MANUFACTURED PRODUCTS COMPANY, INC.
GROUNDWATER TREATMENT COST COMPARISON
EPA FS VS. PROPOSED TREATMENT PLAN

	(EPA GW-3) 30 GPM (FS)	(PROPOSED) 3 GPM
Total Capital	478,988	104,300
Treatability Study	50,000	50,000
	528,988	154,300
Contractor Fee	52,899	---
Legal Fees, Licensing, Permits	52,899	---
Engineering Administration 15%	79,348	23,145
Sub Total	714,134	177,445
Contingency 10%	71,413	17,744
TOTAL CONSTRUCTION COST	785,547	195,189
Present Worth of O & M Costs	1,530,323	293,539
	2,315,870	488,728

APPENDIX G

RESULTS OF GROUNDWATER SAMPLING AND ANALYSIS - AUGUST 4, 1988 SAMPLING ROUND

AUG 24 1988

M.C.P.

M. Anthony Lally Associates
Consulting Environmental Engineers
M. Anthony Lally, P.E.
100 Belmont Street
North Andover, Massachusetts 01845
Tel. (508) 688-1763

August 23, 1988

Mr. James Ciriello
Remedial Project Manager
U.S. Environmental Protection Agency
Waste Management Division
90 Canal Street 2nd Floor
Boston, MA 02114

Re: Modification No. 1 (August 2, 1988) to the
Administrative Order by Consent
U.S. EPA Docket No. 1-87-1091
Groveland Resources Corporation and
Valley Manufactured Products Company, Inc.

Dear Mr. Ciriello:

In accordance with the referenced Modification No. 1 to the Administrative Order by Consent, we are submitting the following Letter Report. This Letter Report is being submitted on behalf of Valley Manufactured Products Company, Inc. As stipulated in the Administrative Order, we are submitting three (3) copies for use and distribution by EPA.

On August 4, 1988 a round of groundwater samples was taken from the following monitoring wells: TW-8, TW-26, TW-3, TW-22, TW-9, TW-17 AND TW-23. Groundwater samples taken from these monitoring wells were submitted to a State Certified Laboratory for analysis of soluble priority pollutant metals.

The procedures which were followed during the groundwater sampling round are contained in the Consent Order, Attachment II, Sampling Procedures.

Water levels, specific conductance, temperature and pH measurements were taken in all monitoring wells prior to purging the well for sampling and again, immediately before samples were collected. This groundwater sampling data is compiled in Table 1 of this correspondence.

Water table elevations were measured in additional monitoring wells TW-11, TW-15 and TW-16. Monitoring well TW-25 was sampled and analyzed for volatile organic compounds. Monitoring well TW-9 was sampled and analyzed for hexavalent chromium. The analytical results for the groundwater samples have been summarized in Table 2 of this correspondence. The data from which Table 2 was compiled is attached to this correspondence for reference.

Water • Wastewater • Solid Waste • Site Development

Mr. James Ciriello
August 23, 1988
Page Two

During the groundwater monitoring round, oil, grease and liquid phase separation were not detected in any of the monitoring wells which were sampled.

Split samples of monitoring wells TW-9, TW-17, TW-23 and TW-25 were provided to the Department of Environmental Quality Engineering.

If you have any questions or require additional information regarding this report, please do not hesitate to contact this office.

Very truly yours,

M. ANTHONY LALLY ASSOCIATES

John L. Falcone, Jr.

JLF/jk
Enclosures

cc: Attorney Martin C. Pentz,
Nutter, McClennen & Fish
Mr. Thomas Quinlan, President,
Valley Manufactured Products, Inc.

TABLE NO. 1

Groundwater Sampling Data
Valley Manufactured Products Company, Inc.
Administrative Order By Consent
U.S. EPA Docket No. 1-87-1091
Modification No. 1

		Initial			Final		
Location	Water Level Feet	pH	Sp. Cond. mmhos/cm	Temp. F°	pH	Sp. Cond. mmhos/cm	Temp. F°
TW-25	45.64	6.25	660	56°	6.30	600	54°
TW-8	31.81	6.31	440	56°	7.30	520	55°
TW-26	31.65	7.02	420	60°	6.32	400	60°
TW-3	33.20	6.09	640	56°	6.32	720	60°
TW-22	19.84	7.14	500	60°	7.20	520	60°
TW-9	23.81	6.50	300	60°	6.24	320	60°
TW-17	35.40	6.30	470	58°	6.20	540	58°
TW-23	24.84	5.93	520	62°	6.01	800	62°
*TW-16	30.10						
*TW-15	Dry						
*TW-11	26.40						

* These wells were not sampled during this sampling round.

TABLE NO. 2

Groundwater Sample Analysis Results*
Valley Manufactured Products Co., Inc.
Administrative Order by Consent
U.S. EPA Docket No. 1-87-1091
Modification No. 1

	TW 3	TW 8	TW 9	TW 17	TW 22	TW 23	TW 25	TW 26
Antimony	ND	ND	ND	ND	ND	ND	NT	ND
Arsenic	ND	ND	ND	ND	ND	ND	NT	0.010 0.007
Beryllium	ND	ND	ND	ND	ND	ND	NT	ND
Cadmium	ND	ND	ND	ND	ND	ND	NT	ND
Chromium	ND	ND	ND	ND	ND	ND	NT	ND
Copper	ND	ND	ND	0.07	ND	0.03	NT	ND
Lead	ND	0.06	ND	0.08	ND	ND	NT	ND
Mercury	ND	ND	ND	ND	ND	ND	NT	ND
Nickel	ND	ND	ND	ND	ND	ND	NT	ND
Selenium	ND	ND	ND	ND	ND	ND	NT	ND
Silver	ND	ND	ND	ND	ND	ND	NT	ND
Thallium	ND	ND	ND	ND	ND	ND	NT	ND
Zinc	0.01	0.04	0.12	0.25	ND	0.18	NT	0.09 0.04
Hex. Chromium	NT	NT	ND	NT	NT	NT	NT	NT
VOC	NT	NT	NT	NT	NT	NT	53.7	NT

* Concentrations are expressed in milligrams per liter (mg/l or ppm)

NT = Not Tested

ND = Not Detected

ALPHA ANALYTICAL LABORATORIES
200 Homer Avenue
Ashland Technology Center
Ashland, Massachusetts 01721
(617) 881-3503

CERTIFICATE OF ANALYSIS

Client: M. A. Lally Associates

Job Number: 881555

Address: 100 Belmont Street
Andover, MA 01845

Invoice Number: 5213

Date In: 08/05/88

Attn: Jay Falcone

Date Reported: 08/18/88

Sample Description: Eight water samples

REFERENCES:

1. Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. EPA SW-846. 1986.
2. Standard Methods for Examination of Water and Waste Water. APHA-AWWA-WPCF. 16th Edition. 1985.
3. Methods for Chemical Analysis of Water and Wastes. EPA 600/4-82-055. 1982.
4. Oil Spill Identification System. CG-D-52-77 U. S. Coast Guard. 1977.

Authorized by:
Scott McLean—Laboratory Director

ALPHA ANALYTICAL LABORATORIES
CERTIFICATE OF ANALYSIS

Client: M. A. Lally Associates

Sample Number: 881555.1

Analysis Requested: Volatile Halocarbons (601)

Date Received: 08/05/88

Date Reported: 08/18/88

Client Ident: TW-25
Sample Location:
Sample Description: Water
Sample Container: VOA vials
Field Prep: None

# of Containers: 2

PARAMETER	RESULT	UNITS	MDL*	INST	REF**	METHOD	EXTRACT	ANALYSIS
Volatile Halocarbons								
1,2-Dichloroethylene	5,500	ug/L	500	GC	1	8010	——	08/18/88
Trichloroethylene	48,200	ug/L	500	GC	1	8010	——	08/18/88

A list of volatile halocarbons analyzed for and their detection limits accompanies this report.

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* MDL—Method Detection Limits (same units as the Results)
** REF—Reference as cited on the cover (first) page of this report.

ALPHA ANALYTICAL LABORATORIES
CERTIFICATE OF ANALYSIS

Client: M. A. Lally Associates

Analysis Requested: Soluble Priority Pollutant 13 Metals

Client Ident: TW-26
Sample Location:
Sample Description: Water
Sample Container: Plastic bottle
Field Prep: None

Sample Number: 881555.2

Date Received: 08/05/88

Date Reported: 08/18/88

# of Containers: 1

PARAMETER	RESULT	UNITS	MDL*	INST	REF**	METHOD	EXTRACT	ANALYSIS
Soluble Priority Pollutant 13 Metals								
Antimony	ND	mg/L	0.50	ICP	1	6010	——	08/10/88
Arsenic	0.010	mg/L	0.005	HGA	1	7060	——	08/10/88
Beryllium	ND	mg/L	0.02	ICP	1	6010	——	08/10/88
Cadmium	ND	mg/L	0.01	ICP	1	6010	——	08/10/88
Chromium	ND	mg/L	0.02	ICP	1	6010	——	08/10/88
Copper	ND	mg/L	0.02	ICP	1	6010	——	08/10/88
Lead	ND	mg/L	0.05	ICP	1	6010	——	08/10/88
Mercury	ND	mg/L	0.0005	CV	1	7040	——	08/10/88
Nickel	ND	mg/L	0.05	ICP	1	6010	——	08/10/88
Selenium	ND	mg/L	0.005	HGA	1	7740	——	08/10/88
Silver	ND	mg/L	0.003	HGA	1	7761	——	08/10/88
Thallium	ND	mg/L	0.50	ICP	1	6010	——	08/10/88
Zinc	0.09	mg/L	0.01	ICP	1	6010	——	08/10/88

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* MDL—Method Detection Limits (same units as the Results)
** REF—Reference as cited on the cover (first) page of this report.

ALPHA ANALYTICAL LABORATORIES
CERTIFICATE OF ANALYSIS

Client: M. A. Lally Associates

Sample Number: 881555.3

Analysis Requested: Soluble Priority Pollutant 13 Metals

Date Received: 08/05/88

Date Reported: 08/18/88

Client Ident: TW-8
Sample Location:
Sample Description: Water
Sample Container: Plastic bottle
Field Prep: None

# of Containers: 1

PARAMETER	RESULT	UNITS	MDL*	INST	REF**	METHOD	EXTRACT	ANALYSIS
Soluble Priority Pollutant 13 Metals								
Antimony	ND	mg/L	0.50	ICP	1	6010	——	08/10/88
Arsenic	ND	mg/L	0.005	HGA	1	7060	——	08/10/88
Beryllium	ND	mg/L	0.02	ICP	1	6010	——	08/10/88
Cadmium	ND	mg/L	0.01	ICP	1	6010	——	08/10/88
Chromium	ND	mg/L	0.02	ICP	1	6010	——	08/10/88
Copper	ND	mg/L	0.02	ICP	1	6010	——	08/10/88
Lead	0.06	mg/L	0.05	ICP	1	6010	——	08/10/88
Mercury	ND	mg/L	0.0005	CV	1	7040	——	08/10/88
Nickel	ND	mg/L	0.05	ICP	1	6010	——	08/10/88
Selenium	ND	mg/L	0.005	HGA	1	7740	——	08/10/88
Silver	ND	mg/L	0.003	HGA	1	7761	——	08/10/88
Thallium	ND	mg/L	0.50	ICP	1	6010	——	08/10/88
Zinc	0.04	mg/L	0.01	ICP	1	6010	——	08/10/88

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* MDL—Method Detection Limits (same units as the Results)

** REF—Reference as cited on the cover (first) page of this report.

ALPHA ANALYTICAL LABORATORIES
CERTIFICATE OF ANALYSIS

Client: M. A. Lally Associates

Sample Number: 881555.3S

Analysis Requested: Soluble Priority Pollutant 13 Metals, Spike Recovery

Date Received: 08/05/88

Date Reported: 08/18/88

Client Ident: TW-8
Sample Location:
Sample Description: Water
Sample Container: Plastic bottle
Field Prep: None

# of Containers: 1

PARAMETER	%RECOVERY
Antimony	94%
Arsenic	120%
Beryllium	80%
Cadmium	90%
Chromium	92%
Copper	88%
Lead	86%
Mercury	80%
Nickel	92%
Selenium	84%
Silver	115%
Thallium	124%
Zinc	91%

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ALPHA ANALYTICAL LABORATORIES
CERTIFICATE OF ANALYSIS

Client: M. A. Lally Associates

Sample Number: 881555.4

Analysis Requested: Soluble Priority Pollutant 13 Metals and Hexavalent Chromium

Date Received: 08/05/88

Date Reported: 08/18/88

Client Ident: TW-9
Sample Location:
Sample Description: Water
Sample Container: Plastic bottle
Field Prep: None

# of Containers: 1

PARAMETER	RESULT	UNITS	MDL*	INST	REF**	METHOD	EXTRACT	ANALYSIS
Soluble Priority Pollutant 13 Metals								
Antimony	ND	mg/L	0.50	ICP	1	6010	——	08/10/88
Arsenic	ND	mg/L	0.005	HGA	1	7060	——	08/10/88
Beryllium	ND	mg/L	0.02	ICP	1	6010	——	08/10/88
Cadmium	ND	mg/L	0.01	ICP	1	6010	——	08/10/88
Chromium	ND	mg/L	0.02	ICP	1	6010	——	08/10/88
Copper	ND	mg/L	0.02	ICP	1	6010	——	08/10/88
Lead	ND	mg/L	0.05	ICP	1	6010	——	08/10/88
Mercury	ND	mg/L	0.0005	CV	1	7040	——	08/10/88
Nickel	ND	mg/L	0.05	ICP	1	6010	——	08/10/88
Selenium	ND	mg/L	0.005	HGA	1	7740	——	08/10/88
Silver	ND	mg/L	0.003	HGA	1	7761	——	08/10/88
Thallium	ND	mg/L	0.50	ICP	1	6010	——	08/10/88
Zinc	0.12	mg/L	0.01	ICP	1	6010	——	08/10/88
Hexavalent Chromium	ND	mg/L	0.01	Spect	2	312B	——	08/05/88

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ALPHA ANALYTICAL LABORATORIES
CERTIFICATE OF ANALYSIS

Client: M. A. Lally Associates

Sample Number: 881555.5

Analysis Requested: Soluble Priority Pollutant 13 Metals

Date Received: 08/05/88

Date Reported: 08/18/88

Client Ident: TW-17
Sample Location:
Sample Description: Water
Sample Container: Plastic bottle
Field Prep: None

# of Containers: 1

PARAMETER	RESULT	UNITS	MDL*	INST	REF**	METHOD	EXTRACT	ANALYSIS
Soluble Priority Pollutant 13 Metals								
Antimony	ND	mg/L	0.50	ICP	1	6010	———	08/10/88
Arsenic	ND	mg/L	0.005	HGA	1	7060	———	08/10/88
Beryllium	ND	mg/L	0.02	ICP	1	6010	———	08/10/88
Cadmium	ND	mg/L	0.01	ICP	1	6010	———	08/10/88
Chromium	ND	mg/L	0.02	ICP	1	6010	———	08/10/88
Copper	0.07	mg/L	0.02	ICP	1	6010	———	08/10/88
Lead	0.08	mg/L	0.05	ICP	1	6010	———	08/10/88
Mercury	ND	mg/L	0.0005	CV	1	7040	———	08/10/88
Nickel	ND	mg/L	0.05	ICP	1	6010	———	08/10/88
Selenium	ND	mg/L	0.005	HGA	1	7740	———	08/10/88
Silver	ND	mg/L	0.003	HGA	1	7761	———	08/10/88
Thallium	ND	mg/L	0.50	ICP	1	6010	———	08/10/88
Zinc	0.25	mg/L	0.01	ICP	1	6010	———	08/10/88

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ALPHA ANALYTICAL LABORATORIES
CERTIFICATE OF ANALYSIS

Sample Number: 881555.6

Client: M. A. Lally Associates

Date Received: 08/05/88

Analysis Requested: Soluble Priority Pollutant 13 Metals

Date Reported: 08/18/88

Client Ident: TW-23
Sample Location:
Sample Description: Water
Sample Container: Plastic bottle
Field Prep: None

# of Containers: 1

PARAMETER	RESULT	UNITS	MDL*	INST	REF**	METHOD	EXTRACT	ANALYSIS
Soluble Priority Pollutant 13 Metals								
Antimony	ND	mg/L	0.50	ICP	1	6010	——	08/10/88
Arsenic	ND	mg/L	0.005	HGA	1	7060	——	08/10/88
Beryllium	ND	mg/L	0.02	ICP	1	6010	——	08/10/88
Cadmium	ND	mg/L	0.01	ICP	1	6010	——	08/10/88
Chromium	ND	mg/L	0.02	ICP	1	6010	——	08/10/88
Copper	0.03	mg/L	0.02	ICP	1	6010	——	08/10/88
Lead	ND	mg/L	0.05	ICP	1	6010	——	08/10/88
Mercury	ND	mg/L	0.0005	CV	1	7040	——	08/10/88
Nickel	ND	mg/L	0.05	ICP	1	6010	——	08/10/88
Selenium	ND	mg/L	0.005	HGA	1	7740	——	08/10/88
Silver	ND	mg/L	0.003	HGA	1	7761	——	08/10/88
Thallium	ND	mg/L	0.50	ICP	1	6010	——	08/10/88
Zinc	0.18	mg/L	0.01	ICP	1	6010	——	08/10/88

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ALPHA ANALYTICAL LABORATORIES
CERTIFICATE OF ANALYSIS

Client: M. A. Lally Associates
Sample Number: 881555.7

Analysis Requested: Soluble Priority Pollutant 13 Metals
Date Received: 08/05/88

Date Reported: 08/18/88

Client Ident: TW-22
Sample Location:
Sample Description: Water
Sample Container: Plastic bottle
# of Containers: 1
Field Prep: None

PARAMETER	RESULT	UNITS	MDL*	INST	REF**	METHOD	EXTRACT	ANALYSIS
Soluble Priority Pollutant 13 Metals								
Antimony	ND	mg/L	0.50	ICP	1	6010	——	08/10/88
Arsenic	ND	mg/L	0.005	HGA	1	7060	——	08/10/88
Beryllium	ND	mg/L	0.02	ICP	1	6010	——	08/10/88
Cadmium	ND	mg/L	0.01	ICP	1	6010	——	08/10/88
Chromium	ND	mg/L	0.02	ICP	1	6010	——	08/10/88
Copper	ND	mg/L	0.02	ICP	1	6010	——	08/10/88
Lead	ND	mg/L	0.05	ICP	1	6010	——	08/10/88
Mercury	ND	mg/L	0.0005	CV	1	7040	——	08/10/88
Nickel	ND	mg/L	0.05	ICP	1	6010	——	08/10/88
Selenium	ND	mg/L	0.005	HGA	1	7740	——	08/10/88
Silver	ND	mg/L	0.003	HGA	1	7761	——	08/10/88
Thallium	ND	mg/L	0.50	ICP	1	6010	——	08/10/88
Zinc	ND	mg/L	0.01	ICP	1	6010	——	08/10/88

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ALPHA ANALYTICAL LABORATORIES
CERTIFICATE OF ANALYSIS

Client: M. A. Lally Associates
Sample Number: 881555.8

Analysis Requested: Soluble Priority Pollutant 13 Metals
Date Received: 08/05/88

Date Reported: 08/18/88

Client Ident: TW-3
Sample Location:
Sample Description: Water
Sample Container: Plastic bottle
# of Containers: 1
Field Prep: None

PARAMETER	RESULT	UNITS	MDL*	INST	REF**	METHOD	EXTRACT	ANALYSIS
Soluble Priority Pollutant 13 Metals								
Antimony	ND	mg/L	0.50	ICP	1	6010	——	08/10/88
Arsenic	ND	mg/L	0.005	HGA	1	7060	——	08/10/88
Beryllium	ND	mg/L	0.02	ICP	1	6010	——	08/10/88
Cadmium	ND	mg/L	0.01	ICP	1	6010	——	08/10/88
Chromium	ND	mg/L	0.02	ICP	1	6010	——	08/10/88
Copper	ND	mg/L	0.02	ICP	1	6010	——	08/10/88
Lead	ND	mg/L	0.05	ICP	1	6010	——	08/10/88
Mercury	ND	mg/L	0.0005	CV	1	7040	——	08/10/88
Nickel	ND	mg/L	0.05	ICP	1	6010	——	08/10/88
Selenium	ND	mg/L	0.005	HGA	1	7740	——	08/10/88
Silver	ND	mg/L	0.003	HGA	1	7761	——	08/10/88
Thallium	ND	mg/L	0.50	ICP	1	6010	——	08/10/88
Zinc	0.01	mg/L	0.01	ICP	1	6010	——	08/10/88

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Volatile Halocarbons by GC
Method 601 and 8010

PARAMETER

Bromodichloromethane
Bromoform
Bromomethane
Carbon tetrachloride
Chlorobenzene
Chloroethane
2-Chloroethylvinyl ether
Chloroform
Chloromethane
Dibromochloromethane
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
Dichlorodifluoromethane
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethene
1,2-Dichloroethene
1,2-Dichloropropane
cis-1,3-Dichloropropene
trans-1,3-Dichloropropene
Methylene chloride
1,1,2,2-Tetrachloroethane
Tetrachloroethene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethene
Trichlorofluoromethane
Vinyl chloride

Method Detection Limit: 500 ug/L